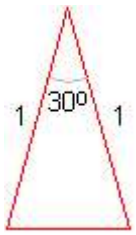
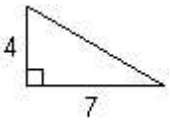
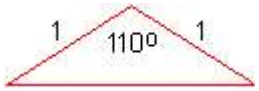
Answers to Odd-Numbered Homework Problems

Homework 1.1

1. 

3. 

5. 

7. $\theta = 108.8°$

9. $\alpha = 29°$ 11. $\beta = 77°$ 13. $\alpha = 12°$ 15. $\theta = 65°$

17. $\theta = 22°$ 19. $\psi = 73°$ 21. $\phi = 88°$

23a. $\phi = 120°$ b. $\phi = 160°$ c. $\phi = \alpha + \beta$ d. An exterior angle is equal to the sum of the opposite interior angles."

25. $\theta = 72°, \phi = 54°$ 27. $\theta = 100°, \phi = 30°$

29a. $2\theta + 2\phi = 180°$ b. $\theta + \phi = 90°$ c. ΔABC is a right triangle.

31a, b. They are base angles of an isosceles triangle. c. Let $\theta = \angle OAB = \angle ABO$ and $\phi = \angle OBC = \angle BCO$, then the triangles from #29 and #31 are the same. From #29, we know that ΔABC is a right triangle.

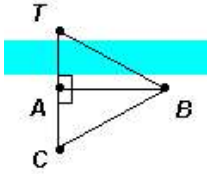
33. $\alpha = 30°, \beta = 60°$ 35. $x = 47°, y = 133°$ 37. $x = 60°, y = 15°$

39. $x = 25°, y = 16°$ 41. $x = 90°, y = 55°$ 43. $x = 50°, y = 80°$

45a. $\angle 1$ & $\angle 4$, $\angle 3$ & $\angle 5$ b. $180°$ c. In the equation $\angle 4 + \angle 2 + \angle 5 = 180°$, substitute $\angle 1$ for $\angle 4$, and substitute $\angle 3$ for $\angle 5$ to see that the sum of the angles is $180°$.

47. $\angle 1 = 130°$ because vertical angles are equal. $\angle 2 = 50°$ because it makes a straight angle with a $130°$ angle. $\angle 3 = 65°$ because it is a base angle of an isosceles triangle whose vertex angle is $50°$. $\angle 4 = 65°$ for the same reason. $\angle 5 = 25°$ because it is complementary to $\angle 4$.

Homework 1.2

1. $\Delta PQT \cong \Delta SRT, x = 7, y = 3, \alpha = 18°$ 3. $\Delta PRE \cong \Delta URN, z = 12,$ $\theta = 10°, \phi = 70°$ 5a,b. 

c. $\Delta ABT \cong \Delta ABC$, so $AT = AC$.

7. Similar: Corresponding sides are proportional. 9. Similar: Corresponding angles are equal.

11. $A = 37°, B = 37°$ 13. $h = 12$ 15. $p = 35$ 17. $g = 84$

19. $h = 30$ 21. 154 feet 23. 1 mile 25. 17.1 sq ft

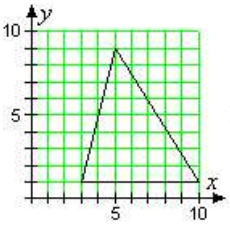
27. $y = \frac{12}{17}x$ 29. $h = 7.5$ 31. $c = 15$ 33. $s = 6$

35. $y = \frac{3}{5}x$ 37. $y = 5 + \frac{3}{4}x$ 39a. $\angle B = 70°, \angle CAD = 70°, \angle DAB = 20°$

b. ΔDBA and ΔDAC. $\overline{BC}$ in ΔABC , $\overline{BA}$ in ΔDBA, and $\overline{AC}$ in ΔDAC. $\overline{AB}$ in ΔABC, $\overline{DB}$ in ΔDBA, and $\overline{DA}$ in ΔDAC. $\overline{AC}$ in ΔABC , $\overline{DA}$ in ΔDBA, and $\overline{DC}$ in ΔDAC.

Homework 1.3

1. 13 miles 3. $10 = 10.00$ 5. $4\sqrt{5} \approx 8.94$ 7. 5 9. $2\sqrt{5}$

11. 5 13. 

24.7 15a. $\sqrt{(x+3)^2 + (y-4)^2}$

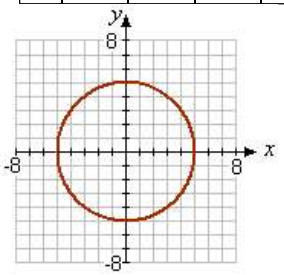
b. $\sqrt{(x+3)^2+(y-4)^2}=5$ 17. The distance between (x, y) and $(4, -1)$ is 3 units.

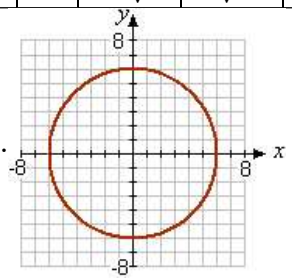
19a. $6\sqrt{2}$ cm b. 8.49 cm 21a. 25π sq in b. 78.54 sq in

23a. approximation b. approximation c. approximation d. exact

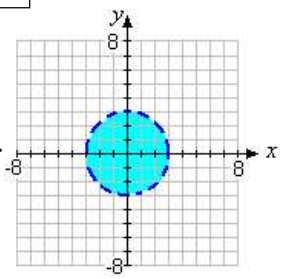
25. a.

x	-5	-4	-3	-2	-1	0	1	2	3	4	5
y	0	± 3	± 4	$\pm\sqrt{21}$	$\pm 2\sqrt{6}$	± 5	$\pm 2\sqrt{6}$	$\pm\sqrt{21}$	± 4	± 3	0

b. 

27a. 

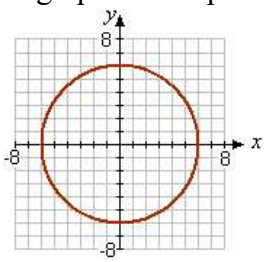
b. $x^2+y^2=36$

29a. 

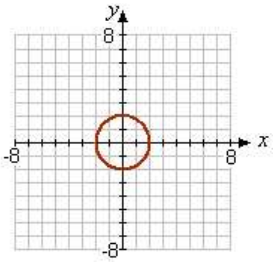
b. $x^2+y^2<9$

31a. No real value of y can satisfy $x^2+y^2=16$ unless $-4 \le x \le 4$.

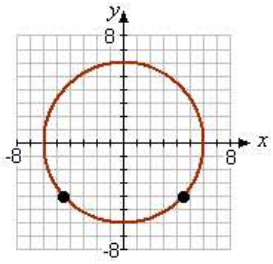
b. The graph has no points where $x>4$ and no points where $x<-4$. 33. $\sqrt{10}$

35a. 

b. 12π

37a. 

b. 4π

39. $\left(-2\sqrt{5}, -4\right)$ and $\left(2\sqrt{5}, -4\right)$ 

41. $P(\frac{1}{2}, \frac{\sqrt{3}}{2})$, $Q(\frac{1}{2}, \frac{-\sqrt{3}}{2})$, $R(\frac{-3}{4}, \frac{\sqrt{7}}{4})$, $S(\frac{-3}{4}, \frac{-\sqrt{7}}{4})$

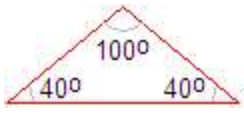
43a. $45°$ b. 5π ft c. 50π sq ft 45a. $\frac{2}{5}$ b. 40π sq ft c. 8π ft

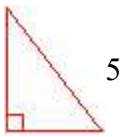
47a. $\frac{1}{10}$ b. $\frac{\pi}{10}$ sq km c. $\frac{\pi}{5}$ km 49a. $\frac{5}{6}$ b. $\frac{15\pi}{2}$ sq m c. 5π m

51. 2070 miles 53a. 54,000 miles b. 2240 mph

55a. $(x-3)^2+(y+2)^2=36$ b. $(x-h)^2+(y-k)^2=r^2$

Chapter 1 Review

1. 

3. 

5. $\alpha=\beta=\gamma=60°$ 7. $\phi=\omega=30°$

9. $\theta=65°, \phi=25°$ 11. $\delta=30°, \gamma=60°$ 13. $\sigma=39°, \omega=79°$

15. $\alpha=51\frac{3}{7}°, \beta=64\frac{2}{7}°$ 17. $\triangle ABC \cong \triangle EDC,\ \alpha=40°, \beta=130°, x=32$

19. Yes, three pairs of equal angles 21. Yes, three pairs of equal angles 23. 13

25. 18 27. $y=\frac{5x}{2}$ 29. $y=\frac{7x}{3}$ 31. $y=\frac{x}{3}$ 33. $x=\frac{25}{13}, y=\frac{60}{13}$

35. $\alpha=70°$ 37. 14 ft 39. $3\frac{3}{4}$ in

41. All sides have length $\sqrt{61}$, opposite sides have slopes $\frac{5}{6}$ and $\frac{-6}{5}$

43. $AC=BC=18$ 45a. $\sqrt{(x-2)^2+(y-5)^2}=3$ b. $(x-2)^2+(y-5)^2=9$

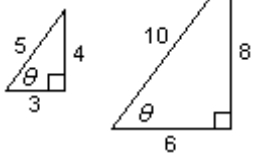
47. $4\sqrt{5} \approx 8.944$ cm 49. $(\frac{-1}{3}, \frac{2\sqrt{2}}{3}), (\frac{-1}{3}, \frac{-2\sqrt{2}}{3})$ 51a. 4π ft b. 20π ft^2
53a. 45°, 60° b. $\frac{49\pi}{8}$ in^2, 6π in^2, Delbert c. $\frac{7\pi}{4}$ in, 2π in, Francine

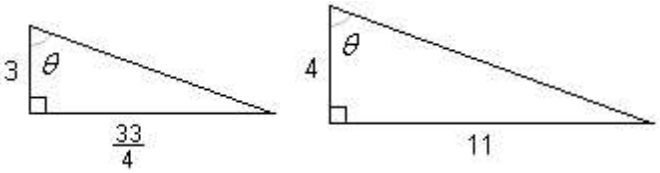
Homework 2.1

1. The sum of the angles is not 180°. 3. The exterior angle is not equal to the sum of the opposite interior angles. 5. The sum of the acute angles is not 90°. 7. The largest side is not opposite the largest angle. 9. The Pythagorean theorem is not satisfied.
11. $5^2 + 12^2 = 13^2$, but the angle opposite the side of length 13 is 85°. 13. $4 < x < 16$
15. $0 < x < 16$ 17. 21 in 19. $6\sqrt{2}$ in 21. $w = 6\sqrt{10}$ in 23. 29 25. $\sqrt{3}$ 27. No
29. Yes 31. No 33. The distance from $(0, 0)$ to $(3, 3)$ is $3\sqrt{2}$, and the distance from $(3, 3)$ to $(6, 0)$ is also $3\sqrt{2}$, so the triangle is isosceles. The distance from $(0, 0)$ to $(6, 0)$ is 6, and $\left(3\sqrt{2}\right)^2 + \left(3\sqrt{2}\right)^2 = 6^2$, so the triangle is a right triangle. 35. 25 ft
37. $\alpha = 30°$, $\beta = 60°$, $h = \sqrt{3}$ 39. $8\sqrt{3}$ in 41a. No b. Yes
43a. $(-1, 0)$ and $(1, 0)$; 2 b. $\sqrt{(p+1)^2 + q^2}$ and $\sqrt{(p-1)^2 + q^2}$
c. $\left(\sqrt{(p+1)^2 + q^2}\right)^2 + \left(\sqrt{(p-1)^2 + q^2}\right)^2 = p^2 + 2p + 1 + q^2 + p^2 - 2p + 1 + q^2$
$= 2p^2 + 2 + 2q^2 = 2 + 2(p^2 + q^2) = 2 + 2(1) = 4$

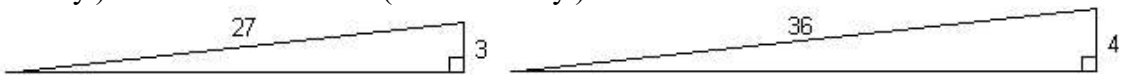
Homework 2.2

1a., b. 0.91 c. 0.906307787 3a., b. 0.77 c. 0.7660444431
5a. $4\sqrt{13} \approx 14.42$ b. $\sin\theta = 0.5547$, $\cos\theta = 0.8321$, $\tan\theta = 0.6667$
7a. $4\sqrt{15} \approx 15.49$ b. $\sin\theta = 0.9682$, $\cos\theta = 0.2500$, $\tan\theta = 3.8730$
9a. $2\sqrt{67} \approx 16.37$ b. $\sin\theta = 0.2116$, $\cos\theta = 0.9774$, $\tan\theta = 0.2165$

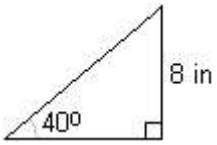
11a., b. 

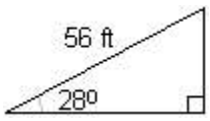
13a., b. 

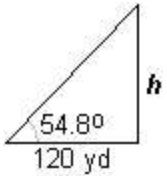
(Answers vary.) (Answers vary.)

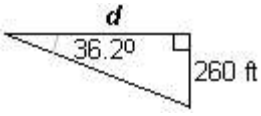
15a., b. 

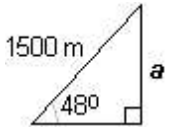
(Answers vary.)

17. 14.41 19. 37.86 21. 86.08 23. 

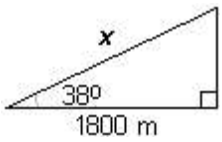
25. 

27a. 

b. $\tan 54.8° = \frac{h}{120}$, 170.1 yd 29a. 

b. $\tan 36.2° = \frac{260}{d}$, 355.2 ft 31a. 

b. $\sin 48° = \frac{a}{1500}$, 1114.7 m

33a. 

b. $\cos 38° = \frac{1800}{x}$, 2284.2 m 35. $x = \dfrac{82}{\tan\theta}$

37. $x = 11\sin\theta$ 39. $x = \dfrac{9}{\cos\theta}$ 41. $36\sin 25° \approx 15.21$ 43. $46\sin 20° \approx 15.73$

45. $12\sin 40° \approx 7.71$

47.

	sin	cos	tan
θ	$\frac{3}{5}$	$\frac{4}{5}$	$\frac{3}{4}$
ϕ	$\frac{4}{5}$	$\frac{3}{5}$	$\frac{4}{3}$

49.

	sin	cos	tan
θ	$\frac{1}{\sqrt{5}}$	$\frac{2}{\sqrt{5}}$	$\frac{1}{2}$
ϕ	$\frac{2}{\sqrt{5}}$	$\frac{1}{\sqrt{5}}$	2

51a. θ and ϕ are complements. b. $\sin\theta = \cos\phi$ and $\sin\phi = \cos\theta$. The side opposite θ is the side adjacent to ϕ, and vice versa.

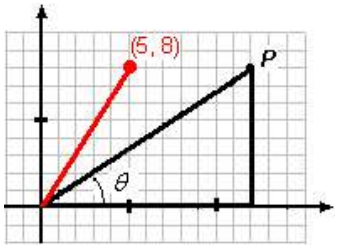
53a. As θ increases, $\tan\theta$ increases also. The side opposite θ increases in length while the side adjacent to θ remains fixed. b. As θ increases, $\cos\theta$ decreases. The side adjacent to θ remains fixed while the hypotenuse increases in length.

55. As θ decreases toward 0°, the side opposite θ approaches a length of 0, so $\sin\theta$ approaches 0. But as θ increases toward 90°, the length of the side opposite θ approaches the length of the hypotenuse, so $\sin\theta$ approaches 1. 57. The triangle is not a right triangle.

59. $\frac{21}{20}$ is the ratio of hypotenuse to the adjacent side, which is the reciprocal of $\cos\theta$.

61a. 0.2358 b. sine c. 48° d. 77° 63a. $\frac{5}{12}$ b. 3 c. $\frac{2}{3}$ d. $\frac{2}{\sqrt{7}}$

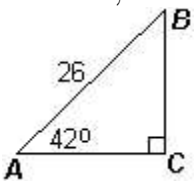
65. Although the triangles may differ in size, the ratio of the side adjacent to the angle to the hypotenuse of the triangle remains the same because the triangles would all be similar, and hence corresponding sides are proportional.

67a. $\frac{2}{3}$ b. $\frac{2}{3}$ c. 

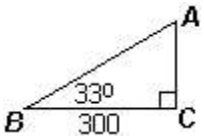
Homework 2.3

1. $A = 61°$, $a = 25.26$, $c = 28.88$

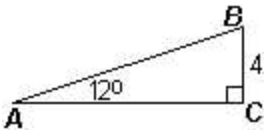
3. $A = 68°$, $a = 0.93$, $b = 0.37$

5a. 

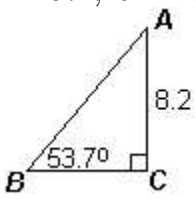
b. $B = 48°$, $a = 17.4$, $b = 19.3$

7a. 

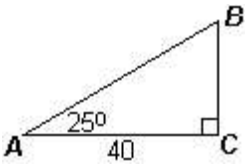
b. $A = 57°$, $b = 194.8$, $c = 357.7$

9a. 

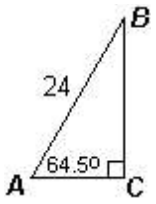
b. $B = 78°$, $b = 18.8$, $c = 19.2$

11a. 

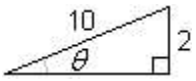
b. Solve $\sin 53.7° = \dfrac{8.2}{c}$ for c. Solve $\tan 53.7° = \frac{8.2}{a}$ for a. Subtract 53.7° from 90° to find A.

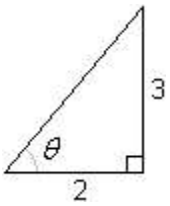
13a. 

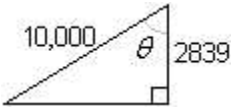
b. Solve $\cos 25° = \frac{40}{c}$ for c.
Solve $\tan 25° = \frac{a}{40}$ for a.
Subtract $25°$ from $90°$ for B.

15a. 

b. Solve $\sin 64.5° = \frac{a}{24}$ for a.
Solve $\cos 64.5° = \frac{b}{24}$ for b.
Subtract $64.5°$ from $90°$ for B.

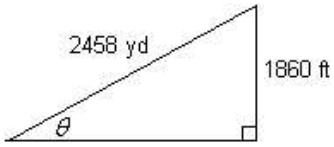
17. $74.2°$ 19. $56.4°$ 21. $66.0°$ 23. $11.5°$ 

25. $56.3°$ 

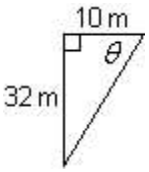
27. $73.5°$ 

29. $\cos 15° = 0.9659$, $\cos^{-1} 0.9659 = 15°$ 31. $\tan^{-1} 2.1445 = 65°$, $\tan 65° = 2.1445$

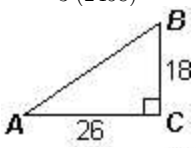
33. $\sin^{-1}(0.6) \approx 36.87°$ is the angle whose sine is 0.6. $(\sin 6°)^{-1} \approx 9.5668$ is the reciprocal of $\sin 6°$.

35a. 

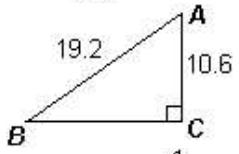
b. $\sin\theta = \frac{1806}{3\cdot(2458)}$, $14.6°$

37a. 

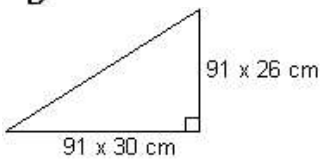
b. $\tan\theta = \frac{32}{10}$, $72.6°$

39a. 

b. $c = 10\sqrt{10} \approx 31.6$, $A \approx 34.7°$, $B \approx 55.3°$

41a. 

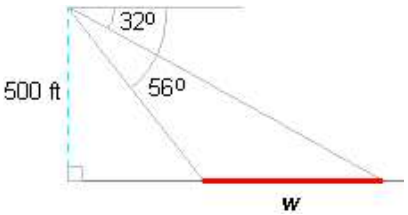
b. $a = \sqrt{256.28} \approx 16.0$, $A \approx 56.5°$, $B \approx 33.5°$

43. 

a. $\tan^{-1}\left(\frac{26}{30}\right) \approx 40.9°$ b. $91\sqrt{1576} \approx 3612.6$ cm

45. 

b. 6415 km

47. 

462.9 ft

49. a and b 51. a. and d. 53. $\frac{\sqrt{3}}{2} \approx 0.8660$ 55. $\frac{1}{\sqrt{3}} = \frac{\sqrt{3}}{3} \approx 0.5774$

57. 1.0000

59.

	0°	30°	45°	60°	90°
sin	0	$\frac{1}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$	1
cos	1	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{1}{2}$	0
tan	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	undefined

Some students notice that the values of the sine ratio are respectively $\frac{\sqrt{0}}{2}$, $\frac{\sqrt{1}}{2}$, $\frac{\sqrt{2}}{2}$, $\frac{\sqrt{3}}{2}$, and $\frac{\sqrt{4}}{2}$. Cosine has the same ratios in reverse order.

61a. smaller b. larger c. larger 63. $a = 3\sqrt{3}$, $b = 3$, $B = 30°$

65. $a = b = 4\sqrt{2}$, $B = 45°$ 67. $e = 4$, $f = 4\sqrt{3}$, $F = 120°$

69. $d = 2\sqrt{3}$, $e = 2\sqrt{2}$, $f = \sqrt{2} + \sqrt{6}$, $F = 75°$ 71. $a = 20$, $b = 20$, $c = 20\sqrt{2}$

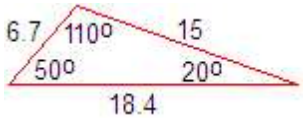
73a. $32\sqrt{3}$ cm b. $128\sqrt{3}$ sq cm 75a. 10 sq cm b. $10\sqrt{2}$ sq cm

c. $10\sqrt{3}$ sq cm 77a. 64 sq in b. $4\sqrt{2}$ by $4\sqrt{2}$, area 32 sq in c. 2 : 1

Chapter 2 Review

1. If $C > 93°$, then $A + B + C > 180°$ 3. If $A < B < 58°$, then $A + B + C < 180°$

5. If $C > 50°$, then $A + B + C > 180°$ 7.



9. $a = 97$ 11. $c = 52$ 13. Yes 15. $\theta = 35.26°$

17. No. $a = 6$, $c = 10$ or $a = 9$, $c = 15$ 19a. $w = 86.05$ b. $\sin\theta = 0.7786$, $\cos\theta = 0.6275$, $\tan\theta = 1.2407$ 21a. $y = 16.52$ b. $\sin\theta = 0.6957$, $\cos\theta = 0.7184$, $\tan\theta = 0.9684$ 23. $a = 7.89$ 25. $x = 3.57$

27. $b = 156.95$ 29. $A = 30°$, $a = \frac{23\sqrt{3}}{3}$, $c = \frac{46\sqrt{3}}{3}$ 31. $F = 105°$, $d = 10\sqrt{2}$, $e = 20$, $f = 10 + 10\sqrt{3}$ 33. 3 cm 35. 43.30 cm

37. 15.92 m 39. 114.02 ft, 37.87° 41a. 60.26° b. 60.26° c. $m = \frac{7}{4} = \tan\theta$

43a. c^2 b. $b - a$, $(b - a)^2$ c. $\frac{1}{2}ab$

d. $4(\frac{1}{2}ab) + (b - a)^2 = 2ab + b^2 - 2ab + a^2 = a^2 + b^2$

Homework 3.1

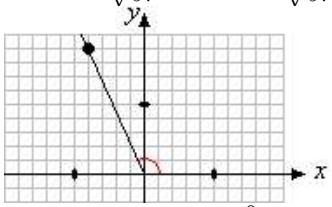
1a. 150° b. 135° c. 60° d. 155° e. 15° f. 70°

3a. $(5, 2)$ b. $\sqrt{29}$ c. $\cos\theta = \frac{5}{\sqrt{29}}$, $\sin\theta = \frac{2}{\sqrt{29}}$, $\tan\theta = \frac{2}{5}$

5a. $(-4, 7)$ b. $\sqrt{65}$ c. $\cos\theta = \frac{-4}{\sqrt{65}}$, $\sin\theta = \frac{7}{\sqrt{65}}$, $\tan\theta = \frac{-7}{4}$

7a. $\sin\theta = \frac{9}{\sqrt{97}}$, $\cos\theta = \frac{4}{\sqrt{97}}$

b.

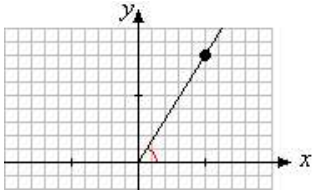


c. $\sin(180° - \theta) = \frac{9}{\sqrt{97}}$, $\cos(180° - \theta) = \frac{-4}{\sqrt{97}}$

d. $\theta = 66°$, $180° - \theta = 114°$

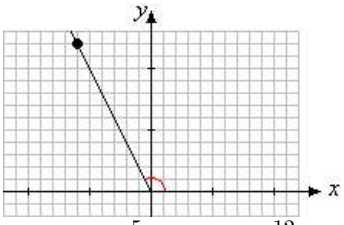
9a. $\sin\theta = \frac{8}{\sqrt{89}}$, $\cos\theta = \frac{-5}{\sqrt{89}}$

b.



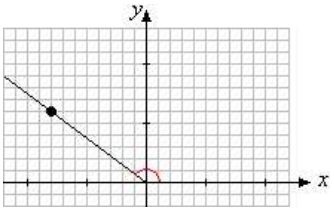
c. $\sin(180° - \theta) = \frac{8}{\sqrt{89}}$, $\cos(180° - \theta) = \frac{5}{\sqrt{89}}$

d. $\theta = 122°$, $180° - \theta = 58°$

11a. 

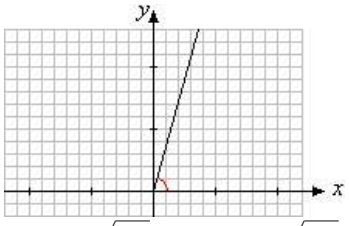
b. $\cos\theta = \frac{-5}{13}$, $\sin\theta = \frac{12}{13}$, $\tan\theta = \frac{-12}{5}$

c. $112.6°$

13a. 

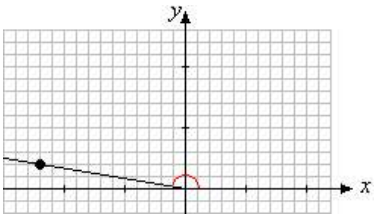
b. $\sin\theta = \frac{3}{5}$, $\tan\theta = \frac{-3}{4}$

c. $143.1°$

15a. 

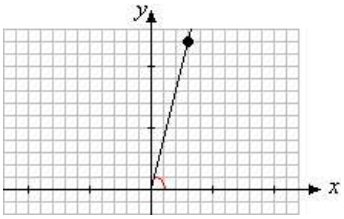
b. $\sin\theta = \frac{\sqrt{112}}{11}$, $\tan\theta = \frac{\sqrt{112}}{3}$

c. $74.2°$

17a. 

b. $\sin\theta = \frac{1}{\sqrt{37}}$, $\cos\theta = \frac{-6}{\sqrt{37}}$

c. $170.5°$

19a. 

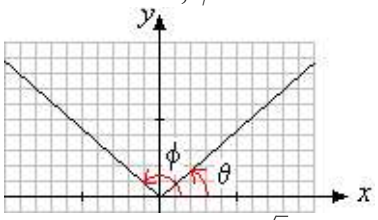
b. $\sin\theta = \frac{4}{\sqrt{17}}$, $\cos\theta = \frac{1}{\sqrt{17}}$ c. $76.0°$

21.

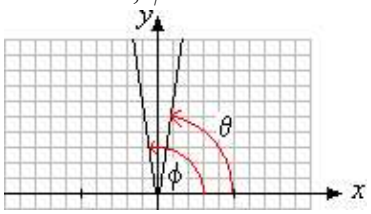
θ	0°	30°	45°	60°	90°	120°	135°	150°	180°
$\cos\theta$	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0	$\frac{-1}{2}$	$\frac{-1}{\sqrt{2}}$	$\frac{-\sqrt{3}}{2}$	-1
$\sin\theta$	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0
$\tan\theta$	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	undefined	$-\sqrt{3}$	-1	$\frac{-1}{\sqrt{3}}$	0

23a. $\sin\theta = \sin(180° - \theta)$ b. $\cos\theta = -\cos(180° - \theta)$ c. $\tan\theta = -\tan(180° - \theta)$

25a. $\theta \approx 41.4°$, $\phi \approx 138.6°$ 27a. $\theta \approx 81.2°$, $\phi \approx 98.8°$

b. 

c. $\sin(\theta) = \sin(\phi) = \frac{\sqrt{7}}{4}$

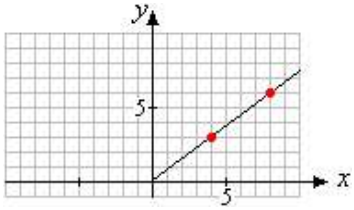
b. 

c. $\sin(\theta) = \sin(\phi) = \frac{\sqrt{156279}}{400} \approx 0.9883$

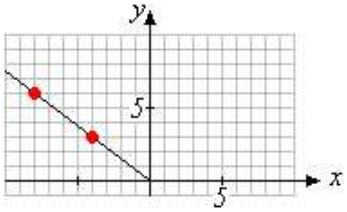
29. $44.4°$ and $135.6°$ 31. $57.1°$ and $122.9°$ 33. $41.8°$ and $138.2°$

35. $\sin 123° = q$, $\cos 33° = q$, $\cos 147° = -q$

37. $\cos 106° = -m$, $\sin 16° = m$, $\sin 164° = m$

39a. 

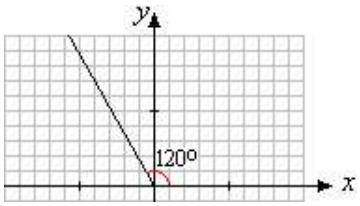
b. $(4, 3)$, $(8, 6)$ c. $\tan^{-1}\left(\frac{3}{4}\right) \approx 36.87°$

d. 

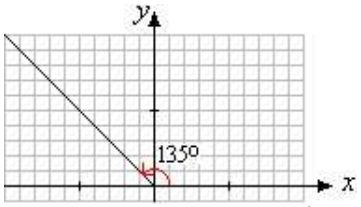
$(-4, 3)$, $(-8, 6)$; $143.13°$

41a. $b = 8$ in, $h = 3\sqrt{3}$ in b. $12\sqrt{3}$ sq in

43a. $b = 6 - \frac{3\sqrt{2}}{2}$ mi, $h = \frac{3\sqrt{2}}{2}$ mi b. $\frac{18\sqrt{2}-9}{4}$ sq mi

45. 

a. $\left(-1, \sqrt{3}\right)$ b. $\left(-\sqrt{3}, 3\right)$

47. 

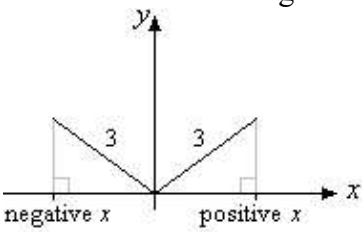
a. $(-3, 3)$ b. $\left(-\sqrt{5}, \sqrt{5}\right)$

49. 20.71 m^2 51. 55.51 cm^2 53. 6.36 in^2 55. 38.04 sq. units

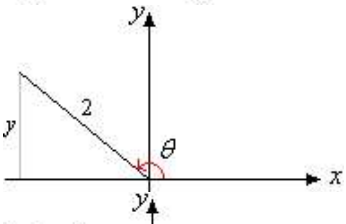
57. 13, 851.3 ft^2 59a. $(-74.97, 59.00)$ b. $BC = 141.97$, $PC = 59.00$

c. 153.74 61. $\dfrac{\sqrt{5}-1}{4}$

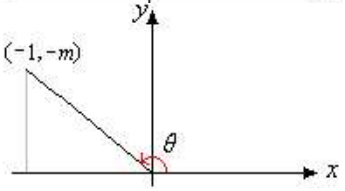
63. Bob found an acute angle. The obtuse angle is the supplement of 17.46°, or 162.54°.

65a. 

b. $\cos\theta = \dfrac{x}{3}$, $\sin\theta = \dfrac{\sqrt{9-x^2}}{3}$, $\tan\theta = \dfrac{\sqrt{9-x^2}}{x}$

67a. 

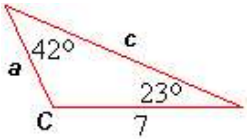
b. $\cos\theta = \dfrac{-\sqrt{4-y^2}}{2}$, $\sin\theta = \dfrac{y}{2}$, $\tan\theta = \dfrac{-y}{\sqrt{4-y^2}}$

69a. 

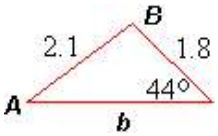
b. $\cos\theta = \dfrac{-1}{\sqrt{1+m^2}}$, $\sin\theta = \dfrac{-m}{\sqrt{1+m^2}}$, $\tan\theta = m$

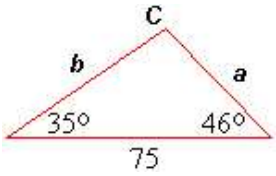
Homework 3.2

1. $x = 7.85$ 3. $q = 33.81$ 5. $d = 28.37$ 7. $\theta = 30.80°$ 9. $\theta = 126.59°$

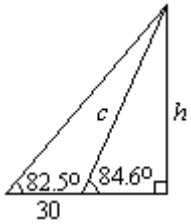
11. $\beta = 37.14°$ 13. 

$a = 4.09$, $c = 9.48$, $C = 115°$

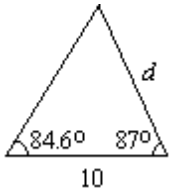
15. 

17. 

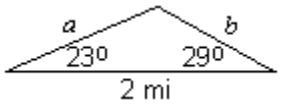
$b = 2.98$, $A = 36.54°$, $B = 99.46°$ $a = 43.55$, $b = 54.62$, $C = 99°$

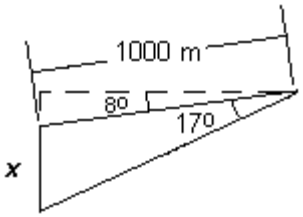
19a. 

b. 808.1 ft

21a. 

b. 68.2 km

23a. 

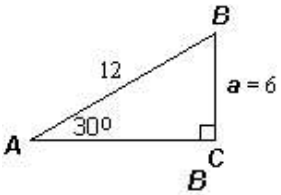
25a. 

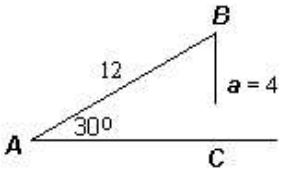
b. $1.23 \text{ mi} + 0.99 \text{ mi}$; 0.22 mi b. 322.6 m

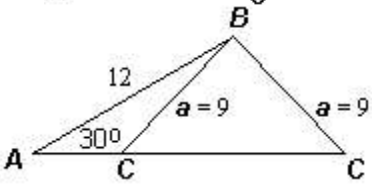
27a. 1° b. 66° c. 2617.2 ft d. 1022.6 ft

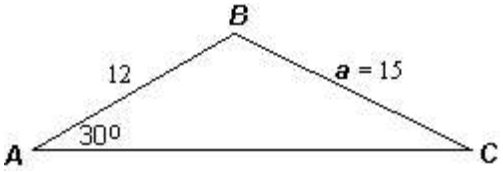
29. $540,000 \text{ AU} \approx 8.1 \times 10^{13}$ km 31. $750{,}000 \text{ AU} \approx 1.1 \times 10^{14}$ km

33a. $\frac{3}{2}$ b. No; a is too short. c. 2 d. 1

35a. 1, 

b. 0, 

c. 2, 

d. 1, 

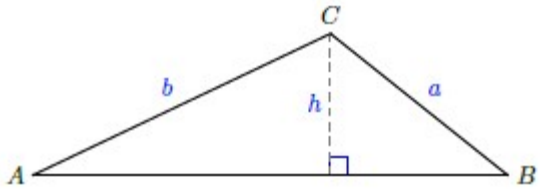
37a. $C = 25.37°$, $B = 114.63°$, $b = 16.97$ b. $C = 58.99°$, $B = 81.01°$, $b = 9.22$; or $C = 121.01°$, $B = 18.99°$, $b = 3.04$ c. no solution d. 5.14

39. $A = 40.44°$, $B = 114.56°$ or $A = 139.56°$, $B = 15.44°$

41. $C = 37.14°$, $A = 93.86°$ 43. 1299 yd or 277.2 yd

45a. 11.79 b. 24.16 c. 24.16

47a. $\frac{1}{2}ab \sin C$ b. $\frac{1}{2}ac \sin B$ c. $\frac{1}{2}bc \sin A$

49a. 

b. $b = \frac{h}{\sin A}$ c. $h = a \sin B$

d. $b = \frac{a \sin B}{\sin A}$ e. ii

Homework 3.3

1a. $74 - 70 \cos \theta$ b. 12.78 c. 135.22 3a. $\dfrac{a^2 + c^2 - b^2}{2bc}$ b. -0.4

5a. $b^2 - (8 \cos \alpha)\, b - 65 = 0$ b. 11.17, -5.82

7. 7.70 9. 13.44 11. 5.12 13. 133.43° 15. 40.64°

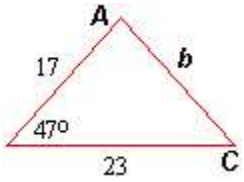
17. $A = 91.02°$, $B = 37.49°$, $C = 51.49°$ 19. $A = 34.34°$, $B = 103.49°$, $C = 42.17°$

21. 6.30 or 2.70 23. 29.76 or 5.91 25. 16.00

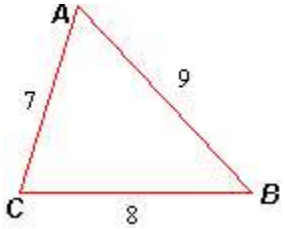
27. Law of Cosines: $61^2 = 29^2 + 46^2 - 2 \cdot 29 \cdot 46 \cos \phi$ 29. Law of Sines: $\dfrac{a}{\sin 46°} = \dfrac{16}{\sin 25°}$

31. First the Law of Cosines: $x^2 = 47^2 + 29^2 - 2 \cdot 47 \cdot 29 \cos 81°$, then second either the Law of Sines: $\dfrac{\sin \theta}{47} = \dfrac{\sin 81°}{x}$ or the Law of Cosines: $47^2 = x^2 + 29^2 - 2 \cdot x \cdot 29 \cos \theta$

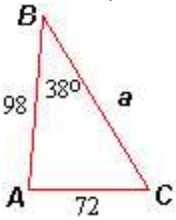
33. Law of Cosines: $9^2 = 4^2 + z^2 - 2 \cdot 4 \cdot z \cos 28°$, or use the Law of Sines first to find the (acute) angle opposite the side of length 4, then find the angle opposite the side of length z by subtracting the sum of the known angles from 180°, then using the Law of Sines again.

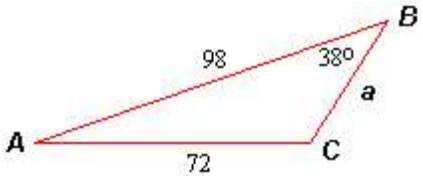
35a. 

b. $b = 16.87$, $A = 85.53°$, $C = 47.47°$

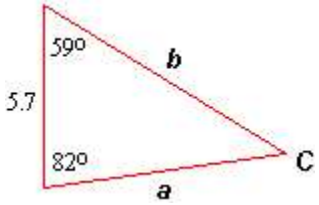
37a. 

b. $A = 58.41°$, $B = 48.19°$, $C = 73.40°$

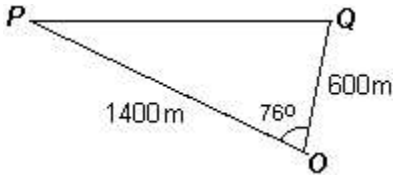
39a. 

or 

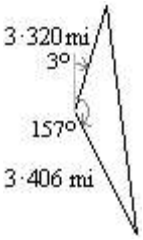
b. $a = 116.52$, $A = 85.07°$, $C = 56.93°$ or $a = 37.93$, $A = 18.93°$, $C = 123.07°$

41a. 

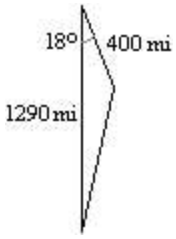
b. $a = 7.76$, $b = 8.97$, $C = 39°$

43a. 

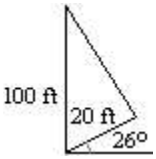
b. 1383.3 m

45a. 

b. 2123 mi, 168.43° east of north

47a. 

b. 7.74° west of south, 917.9 mi

49a. 

b. 92.99 ft

51. 147.73 cm^2 53. 10.53 55. 4.08

57a. First figure: $b - x$ is the base of the small right triangle. Second: $-x$ is the horizontal distance between P and the y-axis, so $b + (-x)$ or $b - x$ is the base of the large right triangle. Third: $x = 0$, and b is the base of a right triangle.

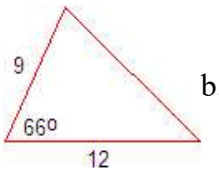
b. First: x and y are the legs of a right triangle, a is the hypotenuse. Second: $-x$ and y are the legs of a right triangle with hypotenuse a. Third: $x = 0$ and $y = a$ c. $x = a\cos C$

59. $b^2 + c^2 = (a^2 + c^2 - 2ac\cos B) + (a^2 + b^2 - 2ab\cos C)$
$= 2a^2 + b^2 + c^2 - 2a(c\cos B + b\cos C)$, so $2a^2 = 2a(c\cos B + b\cos C)$, and dividing both sides by $2a$ yields $a = c\cos B + b\cos C$.

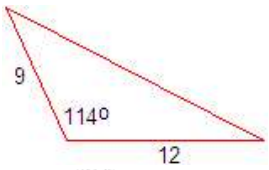
61. For the first equation, start with the Law of Cosines in the form $a^2 = b^2 + c^2 - 2bc\cos A$. Add $2ab + 2bc\cos A - a^2$ to both sides of the equation, factor the right side, then divide both sides by $2bc$. For the second equation, start with the Law of Cosines in the form $b^2 + c^2 - 2bc\cos A = a^2$. Add $2bc - b^2 - c^2$ to both sides of the equation, factor the right side, then divide both sides by $2bc$.

Chapter 3 Review

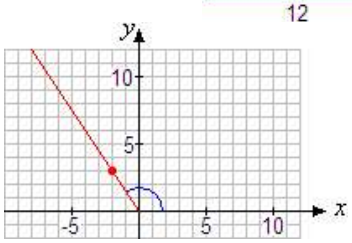
1. $\frac{1}{2}$, $\frac{\pm\sqrt{3}}{2}$

3a. 

b. 49.33

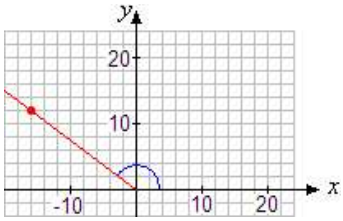
c. 

114°

5a. 

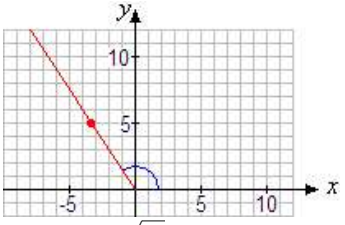
b. $\cos\theta = \frac{-2}{\sqrt{13}}$, $\sin\theta = \frac{3}{\sqrt{13}}$, $\tan\theta = \frac{-3}{2}$

c. $\theta = 123.7°$

7a. 

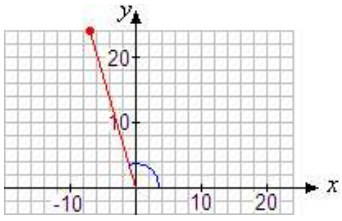
b. $\cos\theta = \frac{-4}{5}$, $\sin\theta = \frac{3}{5}$, $\tan\theta = \frac{-3}{4}$

c. $\theta = 143.1°$

9a. 

b. $\cos\theta = \frac{-\sqrt{11}}{6}$, $\sin\theta = \frac{5}{6}$, $\tan\theta = \frac{-5}{\sqrt{11}}$

c. $\theta = 123.6°$

11a. 

b. $\cos\theta = \frac{-7}{25}$, $\sin\theta = \frac{24}{25}$, $\tan\theta = \frac{-24}{7}$

c. $\theta = 106.3°$

13. 9.9°, 170.1°

15. 22.0°, 158.0°

17a. $7\sqrt{2}$ b. $28\sqrt{2}$

19. 5127.39 sq ft

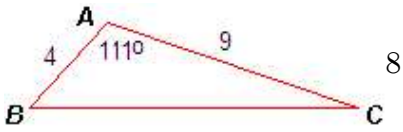
21. 20.41°

23. $a = 27.86$

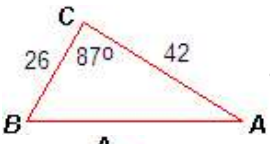
25. $b = 6.03$

27. $w = 62.10$

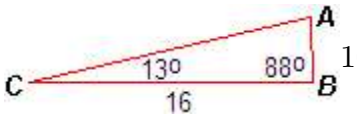
29. $s = 15.61$ or 57.45

31. 

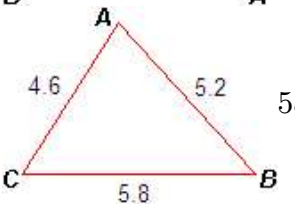
8.82

33. 

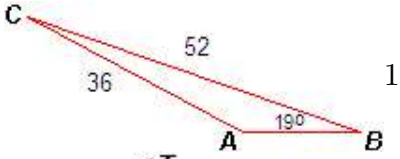
32.57°

35. 

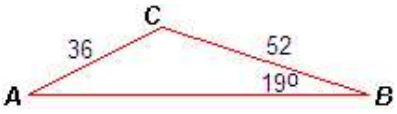
16.29

37. 

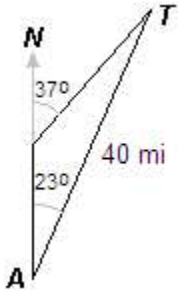
58.65°

39. 

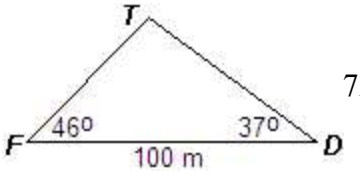
17.40 or



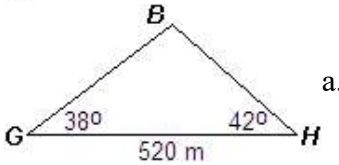
80.93

41. 

16.08 mi, 80.4 mph

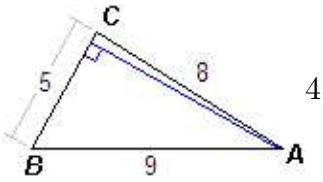
43. 

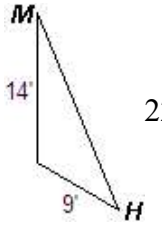
72.47 m

45. 

a. 353.32 m b. 217.52 m

47a. 79.64 m b. 35.2° c. 46.12 m

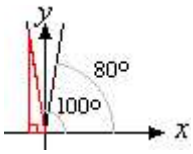
49. 6.1° 51. 

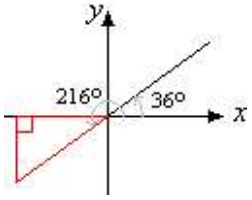
4.2 53. 

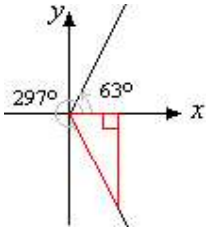
22.25 ft 55. 79, 332.6 AU

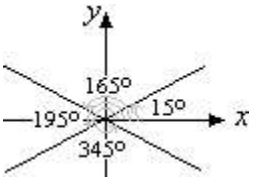
57a. OW bisects the central angle at O, and the inscribed angle θ is half the central angle at O.
b. $\sin\theta = \dfrac{s}{2r}$ c. $r = \dfrac{s}{2\sin\theta}$ d. $d = \dfrac{s}{\sin\theta}$

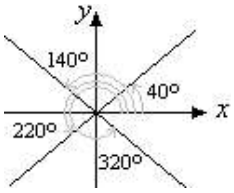
Homework 4.1

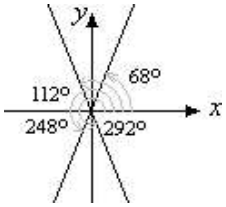
1. a. 216° b. 108° c. 480° d. 960°
3. a. $\frac{1}{8}$ b. $\frac{5}{6}$ c. $\frac{3}{2}$ d. $\frac{7}{6}$ 5a. $\frac{2}{3}$ b. $\frac{5}{3}$
7. 60° 9. 60° 11. 14°
13. 400° and −320° (Answers vary.) 15. 575° and −145° (Answers vary.)
17. 665° and −55° (Answers vary.) 19. 295° 21. 70° 23. 315°
25. 80° 

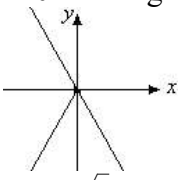
27. 36° 

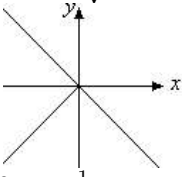
29. 63° 

31. 165°, 195°, 345° 

33. 140°, 220°, 320° 

35. 112°, 248°, 292° 

37. −0.9205 39. −0.7193 41. 4.705 43. −0.7193
45. a. 120° b. 135° c. 150° d. 210° e. 225°
f. 240° g. 300° h. 315° i. 330°
47a. 

b. $\sin 120° = \frac{\sqrt{3}}{2}$, $\cos 120° = \frac{-1}{2}$, $\tan 120° = -\sqrt{3}$,
$\sin 240° = \frac{-\sqrt{3}}{2}$, $\cos 240° = \frac{-1}{2}$, $\tan 240° = \sqrt{3}$, $\sin 300° = \frac{-\sqrt{3}}{2}$, $\cos 300° = \frac{1}{2}$,
$\tan 300° = -\sqrt{3}$
49a. 

b. $\sin 135° = \frac{1}{\sqrt{2}}$, $\cos 135° = \frac{-1}{\sqrt{2}}$, $\tan 135° = -1$,
$\sin 225° = \frac{-1}{\sqrt{2}}$, $\cos 225° = \frac{-1}{\sqrt{2}}$, $\tan 225° = 1$, $\sin 315° = \frac{-1}{\sqrt{2}}$, $\cos 315° = \frac{1}{\sqrt{2}}$, $\tan 315° = -1$
51a. III and IV b. II and III c. I and III
53a. 0° and 180° b. 90° and 270° 55. 105° 57. 264° 59. 313°

61. 83°, 263° 63. 23°, 337° 65. 265°, 275° 67. 156°, 204°

69. 246°, 294° 71. 149°, 329° 73. $(-2\sqrt{2}, 2\sqrt{2})$ 75. $(\frac{3}{2}, \frac{3\sqrt{3}}{2})$

77. $(\frac{-\sqrt{3}}{2}, \frac{-1}{2})$ 79a. $(-0.9, -0.3)$ b. $(-0.940, -0.342)$ c. $(-1.9, -0.7)$

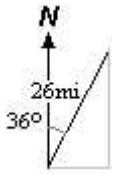
81a. $(-0.9, 0.3)$ b. $(-0.940, 0.342)$ c. $(-1.9, 0.7)$

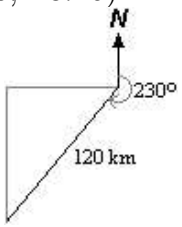
83. Sides of similar triangles are proportional.

Homework 4.2

1. $\left(4\sqrt{2}, -4\sqrt{2}\right)$ 3. $\left(-10, -10\sqrt{3}\right)$ 5. $\left(\frac{-15\sqrt{3}}{2}, \frac{15}{2}\right)$ 7. $(-1.25, -5.87)$

9. $(5.70, -11.68)$ 11. $(9.46, -3.26)$

13a. 

15a. 

17a. 

b. 15.3 mi east, 21 mi north b. 91.9 km west, 77.1 km south b. 30.9 km west, 8.3 km north

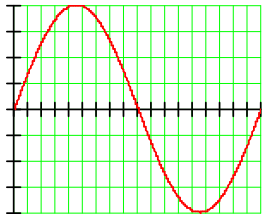
19.

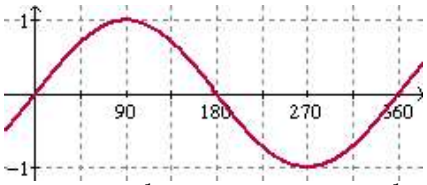
Angle	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
x-coordinate	1	0.98	0.94	0.87	0.77	0.64	0.5	0.34	0.17	0

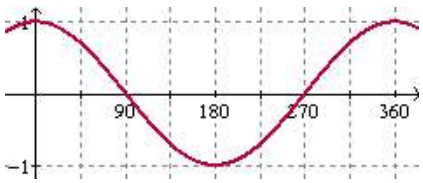
Angle	100°	110°	120°	130°	140°	150°	160°	170°	180°
x-coordinate	−0.17	−0.34	−0.5	−0.64	−0.77	−0.87	−0.94	−0.98	−1

Angle	190°	200°	210°	220°	230°	240°	250°	260°	270°
x-coordinate	−0.98	−0.94	−0.87	−0.77	−0.64	−0.5	−0.34	−0.17	0

Angle	280°	290°	300°	310°	320°	330°	340°	350°	360°
x-coordinate	0.17	0.34	0.5	0.64	0.77	0.87	0.94	0.98	1

21. 

23. 

25. 

27a. $(-225°, \frac{1}{\sqrt{2}})$ b. $(-135°, \frac{-1}{\sqrt{2}})$ c. $(-90°, -1)$ d. $(45°, \frac{1}{\sqrt{2}})$ e. $(180°, 0)$

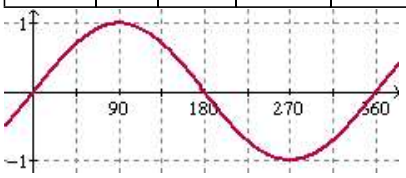
f. $(315°, \frac{-1}{\sqrt{2}})$

29a. $(-240°, \frac{-1}{2})$ b. $(-210°, \frac{-\sqrt{3}}{2})$ c. $(-60°, \frac{1}{2})$ d. $(30°, \frac{\sqrt{3}}{2})$ e. $(120°, \frac{-1}{2})$

f. $(270°, 0)$

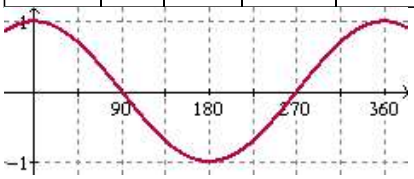
31a.

θ	0°	90°	180°	270°	360°
$\sin\theta$	0	1	0	−1	0

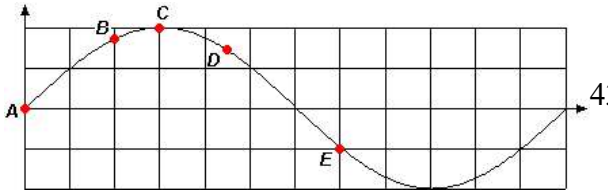


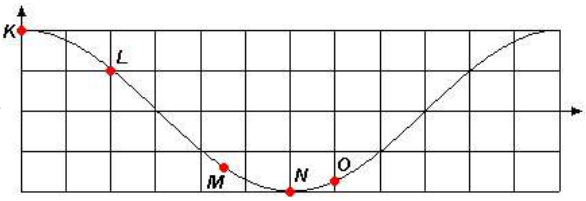
b.

θ	0°	90°	180°	270°	360°
$\cos\theta$	1	0	−1	0	1

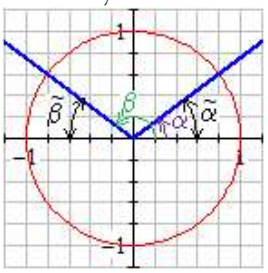


33. $\frac{7}{2}$ 35. $-2\sqrt{2} - 1$ 37. 2 39. $\frac{21}{2}$

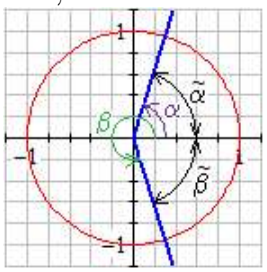
41. 

43. 

45a. 36.9°, 143.1°

b. 

47a. 72.5°, 287.5°

b. 

49. 36.9°, 143.1° 51. 72.5°, 287.5° 53. 191.5°, 348.5° 55. 154.2°, 205.8°

57a.

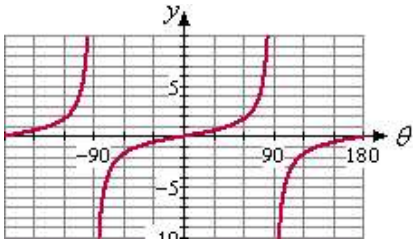
θ	81°	82°	83°	84°	85°	86°	87°	88°	89°
$\tan\theta$	6.314	7.115	8.144	9.514	11.43	14.301	19.081	28.636	57.29

b. $\tan\theta$ approaches ∞.

c.

θ	99°	98°	97°	96°	95°	94°	93°	92°	91°
$\tan\theta$	-6.314	-7.115	-8.144	-9.514	-11.43	-14.301	-19.081	-28.636	-57.29

d. $\tan\theta$ approaches $-\infty$. e. The calculator gives an error message because $\tan 90°$ is undefined.

59. 

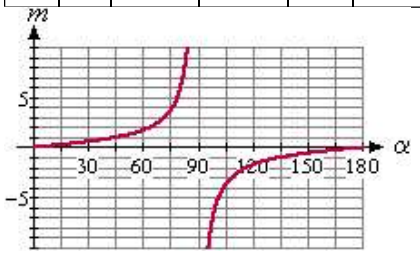
61. 51.34° 63. 159.44°

65. $y + 5 = (\tan 28°)(x - 3)$ or $y + 5 = 0.532(x - 3)$

67. $y - 12 = (\tan 112°)(x + 8)$ or $y - 12 = -2.475(x + 8)$

69.

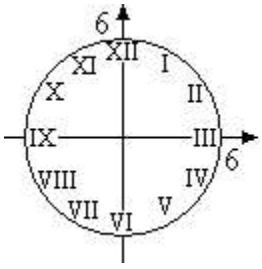
α	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180°
m	0	0.268	0.577	1	1.732	3.732	—	-3.732	-1.732	-1	-0.577	-0.268	0

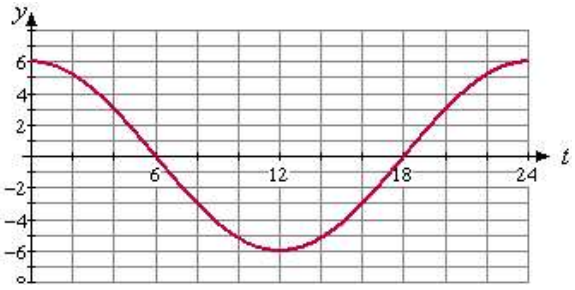


a. The slope increases toward ∞.

b. The slope decreases toward $-\infty$.

Homework 4.3

1a. 

c. 

b.

t	0	2	4	6	8	10	12	14	16	18	20	22	24
θ	90°	60°	30°	0°	330°	300°	270°	240°	210°	180°	150°	120°	90°
$y = f(t)$	6	$3\sqrt{3}$	3	0	-3	$-3\sqrt{3}$	-6	$-3\sqrt{3}$	-3	0	3	$3\sqrt{3}$	6

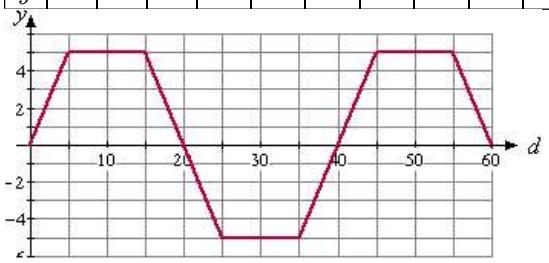
d. The graph from $t = 24$ to $t = 48$ will be exactly the same shape as the graph from $t = 0$ to $t = 24$. $f(t + 24) = f(t)$ says that the ant's y-coordinate 24 seconds after a time t is the same as its y-coordinate at time t.

3a. 2, 5, 5 b. 5

c.

d	0	2	5	8	10	12	15	18	20	22	25	28	30	32	35	38	40
y	0	2	5	5	5	5	5	2	0	-2	-5	-5	-5	-5	-5	-2	0

d.



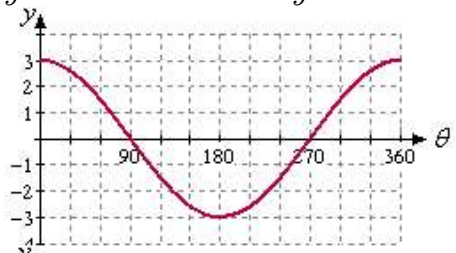
5. a. He will be back in the same position. b. $f(d + 40) = f(d)$

c. The graph for $0 \le d \le 40$ will be exactly the same shape as the graph for $40 \le d \le 80$.

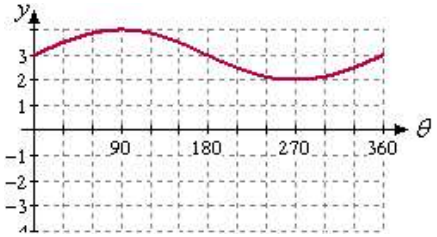
d. Every 40 unit wide piece of the graph will be identical to the previous 40 units.

7. $y = 6 \sin\theta$ 9. $y = \cos\theta - 5$ 11. $y = \sin(4\theta)$

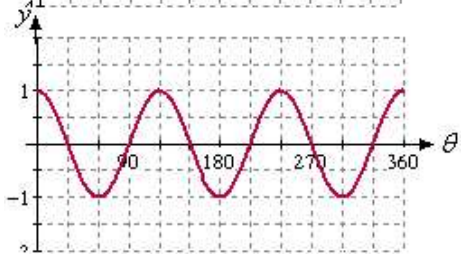
13.



15.



17.



19. amp $= 4$, period $= 360°$, midline: $y = 3$

21. amp $= 5$, period $= 180°$, midline: $y = 0$ 23. amp $= 3$, period $= 120°$, midline: $y = -4$

25a. amp $= 1$, period $= 90°$, midline: $y = 0$ b. $y = \sin 4\theta$

27a. amp $= 1$, period $= 360°$, midline: $y = 3$ b. $y = 3 + \cos\theta$

29a. amp $= 4$, period $= 360°$, midline: $y = -2$ b. $y = -2 + 4\sin\theta$

31a. amp $= 2$, period $= 120°$, midline: $y = 2$ b. $y = 2 + 2\cos 3\theta$

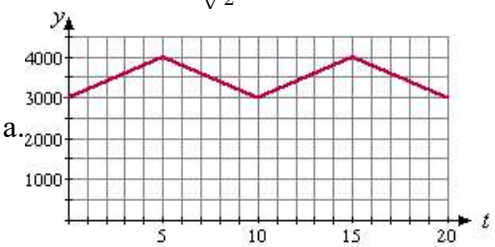
33. $y = 2 + 5\cos\theta$ 35. $y = -4\sin\theta$ 37. $y = -4 + 6\sin 3\theta$ (Answers vary)

39. $y = 3 + 2\cos\theta$ (Answers vary) 41. $y = 12\cos 2\theta$ (Answers vary)

43. $A(0°, -3)$, $B(135°, \frac{-3}{\sqrt{2}})$, $C\left(300°, \frac{-3}{2}\right)$ 45. $P(112.5°, 1)$, $Q(180°, 0)$, $R(337.5°, -1)$

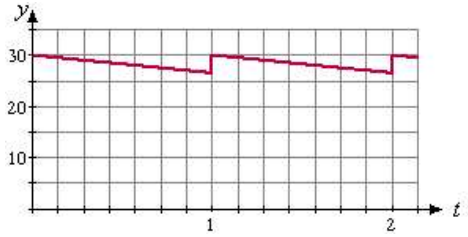
47. $X(45°, -3 + \frac{1}{\sqrt{2}})$, $Y(90°, -3)$, $Z(360°, -2)$ 49. not periodic 51. Periodic with period 4

53a.

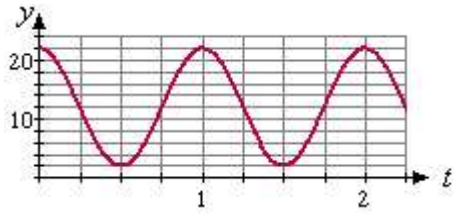


b. 10 minutes

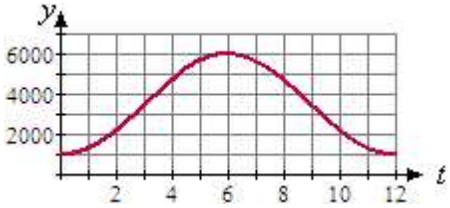
55a.



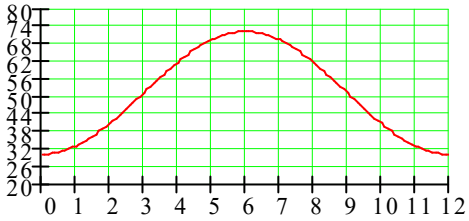
b. 1 week

57. 

b. period 1 sec, midline $y = 12$, amp 10 in.

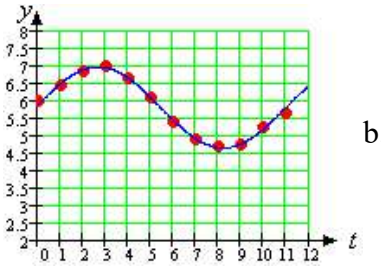
59a. 

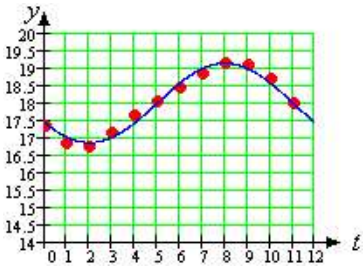
b. period 1 year, midline $y = 3500$, amp 2500

61a. 

b. period 1 year, midline $y = 51$, amp 21

63a. IV b. III c. II d. I

65a. 

b. 

67a. Emotional high: Oct 5 and Nov 3, low: Oct 19; Physical high: Sep 30 and Oct 23, low: Oct 12 and Nov 4; Intellectual high: Oct 10, low: Oct 26

b. Emotional: 28 days, physical: 23 days, intellectual: 32 days c. 5152 days

69a. periodic, period 8 b. 4, midline: $y = 3$ c. $k = 8$ d. $a = 3,\ b = 7$

71a. systolic 120 mm Hg, diastolic 80 mm Hg, pulse pressure 40 mm Hg b. $93\frac{1}{3}$

c. 72 beats per minute 73a. 69 hours b. 2.2 to 3.5 c. The larger dip is when the brighter star is eclipsed, the smaller dip is when the dimmer star is eclipsed.

Chapter 4 Review

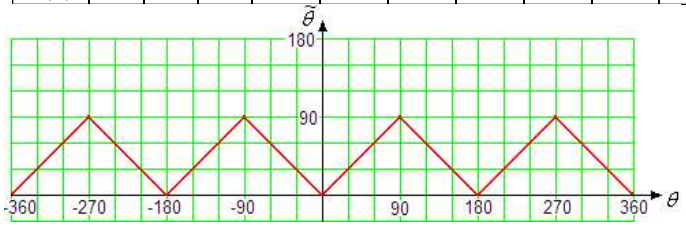
1. 12° 3a. 150°, −210° b. 240°, −120° c. 160°, −560° d. 20°, −340°

5a. I, 60°; 120°, 240°, 300° b. IV, 25°; 155°, 205°, 335°

c. II, 80°; 80°, 260°, 280° d. III, 70°; 70°, 110°, 290°

7a.

θ	30	60	90	120	150	180	210	240	270	300	330	360
$f(\theta)$	30	60	90	60	30	0	30	60	90	60	30	0

b. 

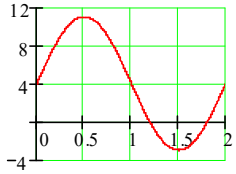
9. 210°, 330°

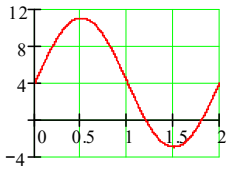
11. 120°, 240° 13. 45°, 225° 15. 23°, 337° 17. 72°, 252°

19. 163°, 277° 21. 221.81°, 318.19° 23. 123.69°, 303.69° 25. 128.68°, 231.32°

27. (−9.74, −2.25) 29. (−0.28, 8.00) 31. (2.84, 0.98) 33. south: 1.74 mi, west: 9.85 mi

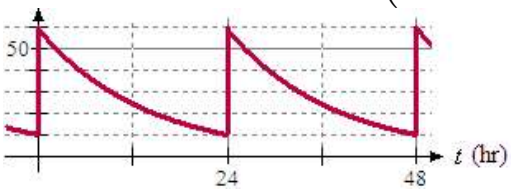
35. $y = 4 + 7\sin(180\,\theta)$ 37. $y = 17 + 7\sin\theta$



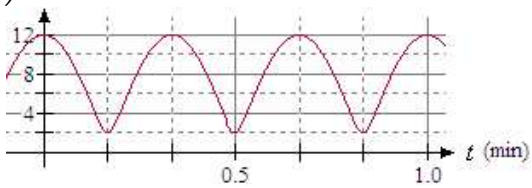


39. $\frac{\sqrt{3}}{2}$ 41. 0 43. $y = 1.5\cos\left(\frac{\theta}{3}\right)$, $M\left(-90°, \frac{3\sqrt{3}}{4}\right)$, $N\left(180°, \frac{3}{4}\right)$

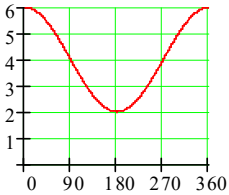
45. $y = 3 + 3\sin 2\theta$, $A(45°, 6)$, $B\left(120°, 3 - \frac{3\sqrt{3}}{2}\right)$

47a. 

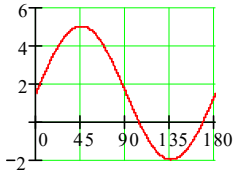
b. 24 hours

49a. 

b. 20 sec

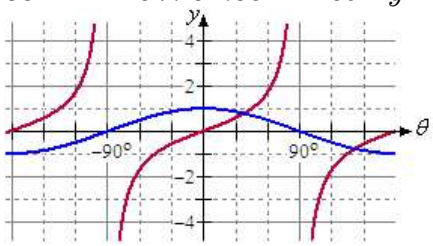
51a. 

b. amp: 2, period: 360°, midline: $y = 4$

53a. 

b. amp: 3.5, period: 180°, midline: $y = 1.5$

55. 30° 57. 92.05° 59. $y = x + 2$ 61. $y = -\sqrt{3}x + 3\sqrt{3} - 4$

63. 

The θ-intercepts of $\cos\theta$ occur at the vertical asymptotes of $\tan\theta$.

Homework 5.1

1. -2 3. $\frac{1}{\sqrt{2}}$ 5. 6 7. $\frac{1}{2}$ 9. 4 11. 2 13. 1 15. 0

17a. 0.7660 b. 0.8164 c. 0.7660 19a. 0.6691 b. 1.8271 c. 0.6691

21a.1 b. 1 c. 1 23a. $-2x^2 - x$ b. $-2\cos^2\theta - \cos\theta$

25a. $4SC$ b. $4\sin\theta\cos\theta$ 27. $5C^2S^3$ b. $5\cos^2\theta\sin^3\theta$

29. $-2\cos t + 2\cos t\sin t$; 0.6360 31. $\tan\theta - \tan\phi$; -56.91

33. $2\sin x\cos x - 2\sin(2x)$; 0 35. No 37. No 39. Yes 41. No 43. No

45a. $2x^2 - x$ b. $2\sin^2 A - \sin A$ 47a. $ab - 3a^2$ b. $\tan A\tan B - 3\tan^2 A$

49a. $2C^2 + C - 1$ b. $2\cos^2\phi + \cos\phi - 1$ 51a. $a^2 - b^2$ b. $\cos^2\theta - \cos^2\phi$

53a. $1 - 2T + T^2$ b. $1 - 2\tan\theta + \tan^2\theta$ 55a. $T^4 - 4$ b. $\tan^4\theta - 4$

57a. $3(3m + 5n)$ b. $3(3\cos\alpha + 5\cos\beta)$ 59a. $5r(r - 2q)$

b. $5\tan C(\tan C - 2\tan B)$ 61a. $(3C + 1)(3C - 1)$ b. $(3\cos\beta + 1)(3\cos\beta - 1)$

63a. $2T^2(3T - 4)$ b. $2\tan^2 A(3\tan A - 4)$ 65a. $(t - 5)(t + 4)$

b. $(\tan\theta - 5)(\tan\theta + 4)$ 67a. $(3c - 1)(c + 1)$ b. $(3\cos\beta - 1)(\cos\beta + 1)$

69a. $(6S + 1)(S - 1)$ b. $(6\sin\alpha + 1)(\sin\alpha - 1)$

Homework 5.2

1. 70° 3. 40° 5. I: 18°; II: 162°; III: 198°; IV: 342°

7. I: 52°; II: 128°; III: 232°; IV: 308°

9a.

x	-1	0	1	2	3
$x^3 - 3x^2 + 4$	0	4	2	0	4

b. -1 or 2

11a.

θ	0°	30°	45°	60°
$\sin\theta + \cos\theta$	1	$\frac{\sqrt{3}+1}{2}$	$\sqrt{2}$	$\frac{\sqrt{3}+1}{2}$

b. 45°

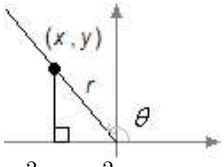
13a.

β	$210°$	$225°$	$240°$	$270°$
$\sin\beta + 2\cos^2\beta$	0	$\frac{2-\sqrt{2}}{2}$	$\frac{1-\sqrt{3}}{2}$	-1

b. $270°$

15. $x = 5, -3$ 17. $x = -3, 1, 2$ 19. $\theta = 30°$ or $\theta = 210°$
21. $\theta = 60°$ or $\theta = 300°$ 23. $\theta = 210°$ or $\theta = 330°$ 25. $\theta = 225°$ or $\theta = 315°$
27. $\theta = 0°$ or $\theta = 180°$ 29. $\theta = 60°$, $\theta = 120°$, $\theta = 240°$, or $\theta = 300°$
31. $\theta = 45°$, $\theta = 135°$, $\theta = 225°$, or $\theta = 315°$ 33. $\theta = 104.04°$ or $\theta = 284.04°$
35. $\theta = 53.13°$ or $\theta = 306.87°$ 37. $\theta = 188.21°$ or $\theta = 351.79°$ 39. $A = 135°$ or $A = 315°$
41. $\phi = 210°$ or $\phi = 330°$ 43. $B = 90°$ or $B = 270°$ 45. $\theta = 210°$ or $\theta = 330°$
47. $t = 202°$ or $t = 338°$ 49. $B = 22°$ or $B = 202°$ 51. $\phi = 146°$ or $\phi = 214°$
53. $\theta = 54.74°$, $\theta = 125.26°$, $\theta = 234.74°$ or $\theta = 305.26°$
55. $\theta = 0°$, $\theta = 180°$, $\theta = 191.54°$ or $\theta = 348.46°$ 57. $\theta = 60°$, $\theta = 180°$, $\theta = 300°$
59. $\theta = 26.57°$, $\theta = 161.57°$, $\theta = 206.57°$ or $\theta = 341.57°$
61. $\theta = 78.69°$, $\theta = 108.43°$, $\theta = 258.69°$ or $\theta = 288.43°$ 63. $\theta = 0$
65. $17.22°$ 67. $35.66°$

Homework 5.3

1. not an identity 3. not an identity 5. identity 7. not an identity
9. not an identity 11. not an identity 13. identity 15. identity
17. $(1+\sin w)(1-\sin w) = 1-\sin^2 w = \cos^2 w$
19. $(\cos\theta - \sin\theta)^2 = \cos^2\theta - 2\cos\theta\sin\theta + \sin^2\theta = (\cos^2\theta + \sin^2\theta) - 2\sin\theta\cos\theta = 1 - 2\sin\theta\cos\theta$
21. $\tan\theta\cos\theta = \frac{\sin\theta}{\cos\theta}\cdot\cos\theta = \sin\theta$
23. $\cos^4 x - \sin^4 x = (\cos^2 x - \sin^2 x)(\cos^2 x + \sin^2 x) = (\cos^2 x - \sin^2 x)(1) = \cos^2 x - \sin^2 x$
25. $\dfrac{\sin u}{1+\cos u} = \dfrac{\sin u}{1+\cos u}\cdot\dfrac{1-\cos u}{1-\cos u} = \dfrac{\sin u(1-\cos u)}{1-\cos^2 u} = \dfrac{\sin u(1-\cos u)}{\sin^2 u} = \dfrac{1-\cos u}{\sin u}$
27. 1 29. 1 31. $\sin^2 A$ 33. $\tan^2 z$ 35. 3 37. 1 39. 6
41. $\cos 2\theta$ 43. $\cos\theta$ 45. $\sin 2t$ 47. $1 + 2\sin\theta + \sin^2\theta$
49. $3\cos^2\phi - 2$ 51. $\theta = 90°$, $\theta = 180°$, $\theta = 270°$ 53. $\theta = 90°$, $\theta = 210°$, $\theta = 330°$
55. $\theta = 210°$, $\theta = 330°$ 57. $\theta = 18.43°$, $\theta = 198.43°$ 59. $\sin A = \frac{-5}{13}$, $\tan A = \frac{-5}{12}$
61. $\cos\phi = \frac{-4\sqrt{3}}{7}$, $\tan\phi = \frac{-1}{4\sqrt{3}}$ 63. $\sin\theta = \frac{-1}{\sqrt{5}}$, $\cos\theta = \frac{2}{\sqrt{5}}$
65. $\sin\theta = \frac{-3}{5}$, $\cos\theta = \frac{-4}{5}$ 67. $\sin\theta = \frac{\sqrt{3}}{2}$, $\cos\theta = \frac{-1}{2}$, $\tan\theta = -\sqrt{3}$
69. $\sin\beta = \frac{2}{\sqrt{5}}$, $\cos\beta = \frac{-1}{\sqrt{5}}$, $\tan\beta = -2$
71. $\sin C = \frac{1}{\sqrt{5}}$, $\cos C = \frac{2}{\sqrt{5}}$, and $\tan C = \frac{1}{2}$ or $\sin C = \frac{1}{\sqrt{5}}$, $\cos C = \frac{-2}{\sqrt{5}}$, and $\tan C = \frac{-1}{2}$
73. $\dfrac{\tan\alpha}{1+\tan\alpha} = \dfrac{\frac{\sin\alpha}{\cos\alpha}}{1+\frac{\sin\alpha}{\cos\alpha}} = \dfrac{\frac{\sin\alpha}{\cos\alpha}}{1+\frac{\sin\alpha}{\cos\alpha}}\cdot\dfrac{\cos\alpha}{\cos\alpha} = \dfrac{\sin\alpha}{\cos\alpha+\sin\alpha}$
75. $\dfrac{1+\tan^2\beta}{1-\tan^2\beta} = \dfrac{\frac{1}{\cos^2\beta}}{1-\frac{\sin^2\beta}{\cos^2\beta}} = \dfrac{\frac{1}{\cos^2\beta}}{1-\frac{\sin^2\beta}{\cos^2\beta}}\cdot\dfrac{\cos^2\beta}{\cos^2\beta} = \dfrac{1}{\cos^2\beta - \sin^2\beta}$
77. 

a. By the distance formula, $\sqrt{x^2+y^2} = r$, or, $x^2 + y^2 = r^2$
b. $\dfrac{x^2}{r^2} + \dfrac{y^2}{r^2} = 1$ c. $\left(\dfrac{x}{r}\right)^2 + \left(\dfrac{y}{r}\right)^2 = 1$ d. $(\cos\theta)^2 + (\sin\theta)^2 = 1$

Chapter 5 Review

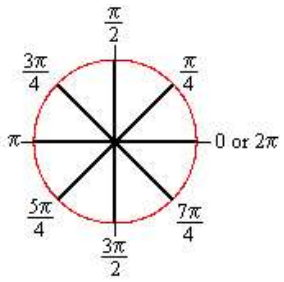
1. $\frac{-3}{4\sqrt{2}}$ 3. $\frac{1}{\sqrt{6}}$ 5a. 0.8660 b. 0.9848; No 7a. 1.4281 b. 1.4281; Yes

9. $5\sin x - 2\sin x\cos y - \cos y$ 11. $2\tan\theta - 10\tan^2\theta$ 13. Not equivalent
15. Equivalent 17. $2\cos^2\alpha + \cos\alpha - 6$ 19. $\tan^2\phi - 2\tan\phi\cos\phi + \cos^2\phi$
21. $6(2\sin 3x - \sin 2x)$ 23. $(1+3\tan\theta)(1-3\tan\theta)$ 25. $\cos\alpha + \sin\alpha$
27. $\frac{3}{2}$ 29. $\dfrac{3\tan C + 2}{\tan C - 2}$ 31. 51.32°, 308.68° 33. 90°, 270°, 120°, 240°
35. 90°, 210°, 330° 37. 30°, 150°, 210°, 330° 39. 0°, 120°, 240°
41. 57.99°, 237.99° 43. 90°, 270° 45. 33.17° 47. Identity
49. Not an identity 51. Not an identity 53. Identity
55. $\dfrac{1-\cos^2\alpha}{\tan\alpha} = \sin^2\alpha \cdot \dfrac{\cos\alpha}{\sin\alpha} = \sin\alpha\cos\alpha$
57. $\dfrac{\frac{\sin\theta}{\cos\theta} - \sin\theta\cos\theta}{\sin\theta\cdot\frac{\sin\theta}{\cos\theta}} = \dfrac{\sin\theta - \sin\theta\cos^2\theta}{\sin^2\theta} = \dfrac{\sin\theta\,(1-\cos^2\theta)}{\sin^2\theta} = \dfrac{\sin\theta\sin^2\theta}{\sin^2\theta} = \sin\theta$
59. $\dfrac{1}{\sin\theta\cos\theta}$ 61. 1 63. 0 65. 1 67. $\dfrac{1}{\cos^2\beta}$
69. $2 + \cos t - 2\cos^2 t$ 71. $\sin\beta = \dfrac{-6}{\sqrt{85}}$, $\cos\beta = \dfrac{-7}{\sqrt{85}}$, $\tan\beta = \dfrac{6}{7}$
73. $\sin\alpha = \dfrac{\sqrt{21}}{5}$, $\cos\alpha = \dfrac{-2}{5}$, $\tan\alpha = \dfrac{-\sqrt{21}}{2}$ 75. 0°, 180°, 270° 77. 135°, 315°
79. 0°, 60°, 180°, 300° 81. 0°, 180°

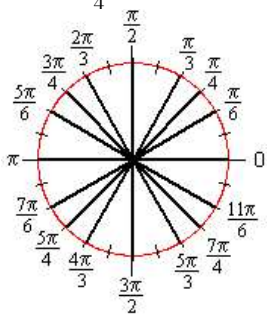
Homework 6.1

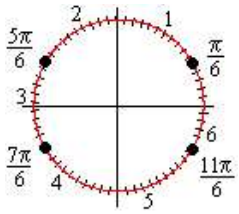
1a.

Radians	0	$\frac{\pi}{4}$	$\frac{\pi}{2}$	$\frac{3\pi}{4}$	π	$\frac{5\pi}{4}$	$\frac{3\pi}{2}$	$\frac{7\pi}{4}$	2π
Degrees	0°	45°	90°	135°	180°	225°	270°	315°	360°

b. 

3a. $120° = \frac{2\pi}{3}$ radians b. $240° = \frac{4\pi}{3}$ radians c. $480° = \frac{8\pi}{3}$ radians d. $600° = \frac{10\pi}{3}$ radians
5a. $45° = \frac{\pi}{4}$ radians b. $135° = \frac{3\pi}{4}$ radians c. $225° = \frac{5\pi}{4}$ radians d. $315° = \frac{7\pi}{4}$ radians

7. 

9a. 0.52 b. 2.62 c. 3.67 d. 5.76 11. 

13. 2.09 15. 2.62 17. 0.52 19. 2.36 21a. II b. IV c. IV d. I
23a. III b. II c. I d. IV

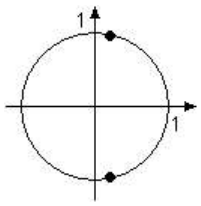
25.

Radians	$\frac{\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$
Degrees	30°	45°	60°

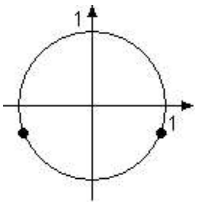
27.

Radians	$\frac{7\pi}{6}$	$\frac{5\pi}{4}$	$\frac{4\pi}{3}$
Degrees	210°	225°	240°

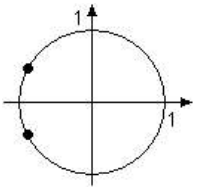
29a. 1.31 b. 4.12 c. 5.71 31a. 45.8° b. 200.5° c. 292.2°
33. 5.86 in 35. 4.13 m 37. 160.42° 39a. $\frac{5\pi}{6}$ b. 32.72 ft
41. $\frac{8}{67}$ radians $\approx 6.84°$ 43a. $33{,}000\pi \approx 103{,}672.6$ in
b. $33{,}000\pi \approx 103{,}672.6$ in per min 45. $170\pi \approx 534.1$ m per min

47. 

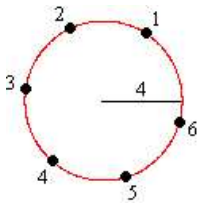
$(0.2,\ 0.98),\ (0.2,\ -0.98)$

49. 

$(0.94,\ -0.35),\ (-0.94,\ -0.35)$

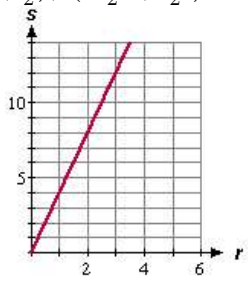
51. 

$\left(\frac{-\sqrt{3}}{2}, \frac{1}{2}\right),\ \left(\frac{-\sqrt{3}}{2}, \frac{-1}{2}\right)$

53a. 

b.

θ	1	2	3	4	5	6
s	4	8	12	16	20	24

c. 

$m = 4$

d. Arclength doubles; arclength triples.

55a. $\frac{\pi}{10}$ radians per min b. $\frac{10\pi}{9}$ radians per sec 57a. $\frac{\theta}{2\pi}$ b. $\frac{3}{8}, \frac{5}{6}, \frac{7}{12}$

59. 32.5 cm^2

Homework 6.2

1.

	a	*b*	*c*	*d*
t	$\frac{\pi}{4}$	$\frac{3\pi}{4}$	$\frac{5\pi}{4}$	$\frac{7\pi}{4}$
x	$\frac{1}{\sqrt{2}}$	$\frac{-1}{\sqrt{2}}$	$\frac{-1}{\sqrt{2}}$	$\frac{1}{\sqrt{2}}$
y	$\frac{1}{\sqrt{2}}$	$\frac{1}{\sqrt{2}}$	$\frac{-1}{\sqrt{2}}$	$\frac{-1}{\sqrt{2}}$

3.

	a	*b*	*c*	*d*
t	$\frac{\pi}{3}$	$\frac{2\pi}{3}$	$\frac{4\pi}{3}$	$\frac{5\pi}{3}$
x	$\frac{1}{2}$	$\frac{-1}{2}$	$\frac{-1}{2}$	$\frac{1}{2}$
y	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{3}}{2}$	$\frac{-\sqrt{3}}{2}$	$\frac{-\sqrt{3}}{2}$

5a. $\sin 0.4 \approx 0.39, \cos 0.4 \approx 0.92, \tan 0.4 \approx 0.42$ b. $\sin 1.2 \approx 0.93, \cos 1.2 \approx 0.36, \tan 1.2 \approx 2.6$ c. $\sin 2 \approx 0.91, \cos 2 \approx -0.42, \tan 2 \approx -2.2$

7a. $\sin 2.8 \approx 0.33, \cos 2.8 \approx -0.94, \tan 2.8 \approx -0.36$ b. $\sin 3.5 \approx -0.35, \cos 3.5 \approx -0.94, \tan 3.5 \approx 0.37$ c. $\sin 5 \approx -0.96, \cos 5 \approx 0.28, \tan 5 \approx -3.3$

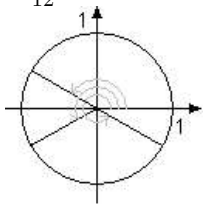
9. $t \approx 1.27$ or $t \approx 5$ 11. $t \approx 3.92$ or $t \approx 5.5$ 13. $t \approx 2.72$ or $t \approx 5.87$

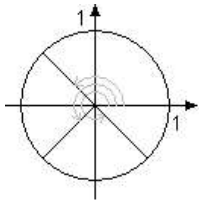
15. II 17. II 19. III 21. Negative 23. Positive 25. Positive

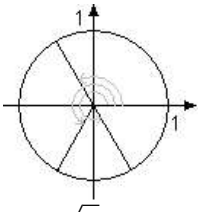
27. $\sin 3.5, \sin 0.5, \sin 2.5, \sin 1.5$ 29. $\cos 3, \cos 4, \cos 2, \cos 5$

31. January 1: 4:24; April 1: 6:45; July 1: 8:02; October 1: 5:55 33. 1.34 35. 0.84

37. 0.02 39. $\frac{1}{12}\pi$ 41. $\frac{1}{3}\pi$ 43. $\frac{1}{4}\pi$

45a. $\frac{5\pi}{6}, \frac{7\pi}{6}, \frac{11\pi}{6}$ 

b. $\frac{3\pi}{4}, \frac{5\pi}{4}, \frac{7\pi}{4}$ 

c. $\frac{2\pi}{3}, \frac{4\pi}{3}, \frac{5\pi}{3}$ 

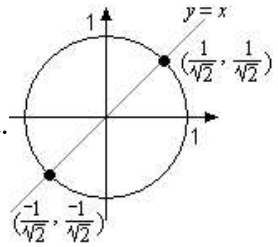
47.

θ	$\sin\theta$	$\cos\theta$	$\tan\theta$
$\frac{7\pi}{6}$	$\frac{-1}{2}$	$\frac{-\sqrt{3}}{2}$	$\frac{1}{\sqrt{3}}$
$\frac{5\pi}{4}$	$\frac{-1}{\sqrt{2}}$	$\frac{-1}{\sqrt{2}}$	1
$\frac{4\pi}{3}$	$\frac{-\sqrt{3}}{2}$	$\frac{-1}{2}$	$\sqrt{3}$

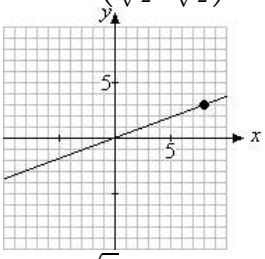
49. $\frac{1}{4}$ 51. $-\dfrac{3+\sqrt{3}}{3}$ 53. $\dfrac{3-6\sqrt{3}}{4}$

55. $(\cos 2.5, \sin 2.5) \approx (-0.8, 0.6)$ 57. $(\cos 8.5, \sin 8.5) \approx (-0.6, 0.8)$

59. $\cos 5 \approx 0.28$ mi east, $\sin 5 \approx -0.96$ mi north, or about 0.96 mi south 61. 1.75

63. 5.8 65. 3.84 67a. 

Intersections: $\left(\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}\right)$ and $\left(\frac{-1}{\sqrt{2}}, \frac{-1}{\sqrt{2}}\right)$ b. $\left(\cos\frac{\pi}{4}, \sin\frac{\pi}{4}\right)$ and $\left(\cos\frac{5\pi}{4}, \sin\frac{5\pi}{4}\right)$

69a. 

$m = \frac{3}{8}$ b. $\tan^{-1}\left(\frac{3}{8}\right) \approx 0.3588$

71. $y - 2 = \sqrt{3}(x - 4)$ 73. $y + 8 = (\tan 2.4)(x - 5)$ or $y + 8 = -0.916(x - 5)$

75. Any point (x, y) on the terminal side of θ satisfies $\cos\theta = \frac{x}{r}$, $\sin\theta = \frac{y}{r}$. For the point P where $r = 1$, $\cos\theta = x$, $\sin\theta = y$. The arc of length t is spanned by an angle θ in standard position. Because arclength is $r\theta$ and $r = 1$, $t = \theta$, so $x = \cos t$, $y = \sin t$.

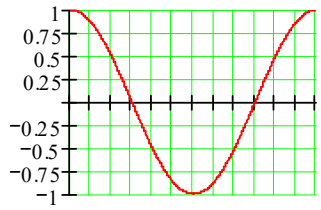
77. The two right triangles shown are similar, so their sides are proportional. The hypotenuse of the large triangle is r times the hypotenuse of the small triangle, so the two legs of the large triangle must be r times the legs of the small triangle. Thus, because the coordinates of the vertex on the unit circle are $(\cos\theta, \sin\theta)$, the coordinates of P must be $(r\cos\theta, r\sin\theta)$.

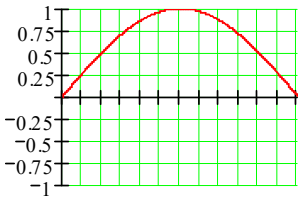
79. 71 m west, 587 m north

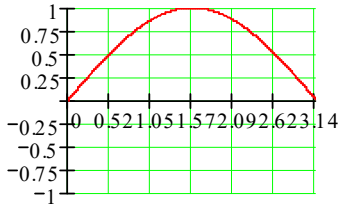
Homework 6.3

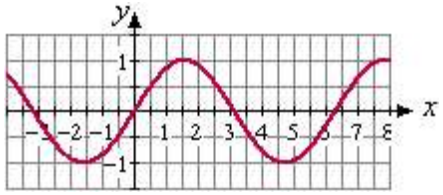
1a.

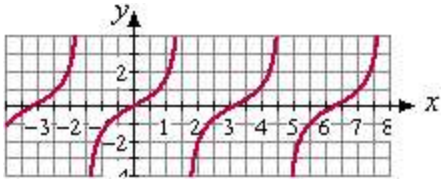
θ	0	$\frac{\pi}{12}$	$\frac{\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$	$\frac{5\pi}{12}$	$\frac{\pi}{2}$	$\frac{7\pi}{12}$	$\frac{2\pi}{3}$	$\frac{3\pi}{4}$	$\frac{5\pi}{6}$	$\frac{11\pi}{12}$	π
$\cos\theta$	1	0.97	0.87	0.71	0.50	0.26	0	−0.26	−0.50	−0.71	−0.87	−0.97	−1

b. 

3a. 

b. 

5a. 

7a. 

b. Domain: $(-\infty, \infty)$, range: $[-1, 1]$ b. Domain: $x \neq \frac{n\pi}{2}$, n odd integer; range: $(-\infty, \infty)$

9a. $x \approx 0.7$ or $x \approx 2.4$ b. $x \approx 0.36$ or $x \approx 2.78$ 11a. $x \approx 2$ or $x \approx 4.3$

b. $x \approx 2.5$ or $x \approx 3.79$ 13. $x \approx 1.3$ or $x \approx 4.5$ 15. $x \approx 2.7$ or $x \approx 5.8$

17. $x \approx 1.4$ or $x \approx 4.5$ 19. $x \approx 2.2$ or $x \approx 5.3$

21. I: 0.5, II: 2.7, III: 3.6, IV: 5.8 23. I: 0.6, II: 2.6, III: 3.7, IV: 5.7

25. I: 1.3, II: 1.8, III: 4.5, IV: 4.9 27. $t \approx 0.74$ or $t \approx 5.55$

29. $t \approx 1.01$ or $t \approx 4.15$ 31. $x \approx 3.94$ or $x \approx 5.48$ 33. $t = \frac{3\pi}{2}$

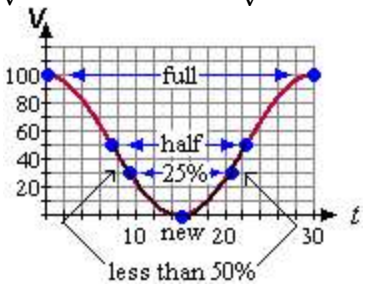
35. $x = \frac{\pi}{4}$ or $x = \frac{5\pi}{4}$ 37. $z = \frac{\pi}{3}$ or $z = \frac{5\pi}{3}$ 39. $s = \frac{2\pi}{3}$ or $s = \frac{5\pi}{3}$

41. $t = \frac{5\pi}{4}$ or $t = \frac{7\pi}{4}$ 43. $x = \frac{5\pi}{6}$ or $x = \frac{7\pi}{6}$ 45a. 0.78 b. 1.12

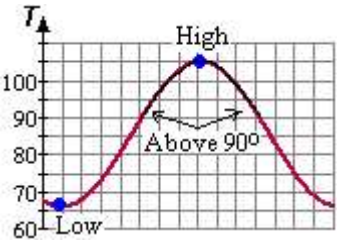
47a. 0.26 b. 1.28 49a. -0.9 b. No solution 51a. $\frac{1}{\sqrt{2}}$ b. 0.9

53. $-6\sqrt{2}$ 55. $-4\sqrt{3}$ 57. 6

59b-c.



61b-c.

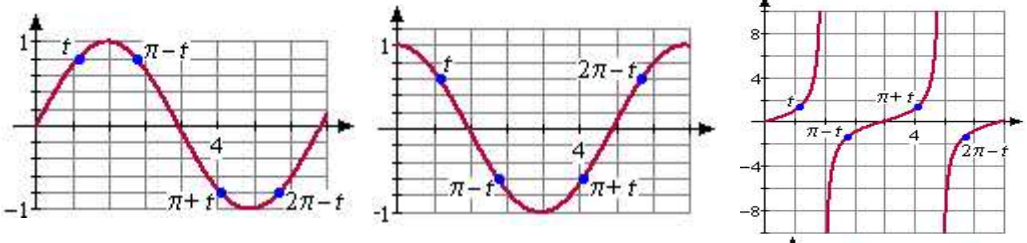


d. $t \approx 10$ and $t \approx 20$ e. $t \approx 7.5$ to $t \approx 22$ d. High: day 204, 105°; low: day 25, 66°

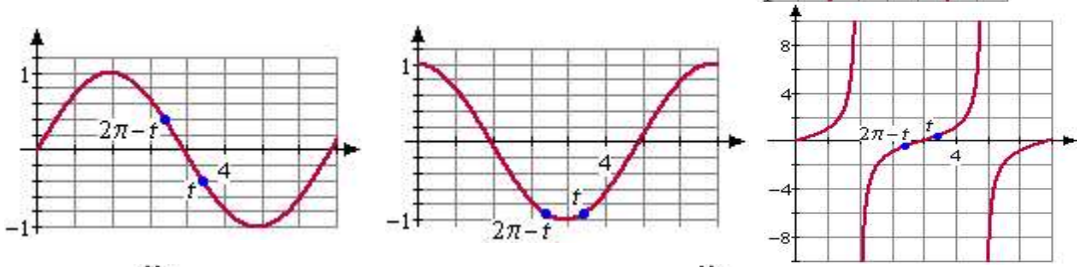
e. $d \approx 128$ to $d \approx 281$ 63a. $-0.8, 0.6, \frac{-4}{3}$ b. $0.8, -0.6, \frac{-4}{3}$ c. $-0.8, -0.6, \frac{4}{3}$

65a. $0.92, -0.39, \frac{-92}{39}$ b. $-0.92, 0.39, \frac{-92}{39}$ c. $0.92, 0.39, \frac{92}{39}$

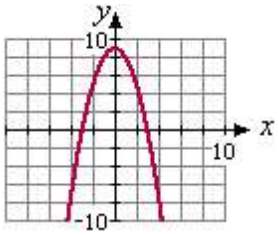
67.



69.

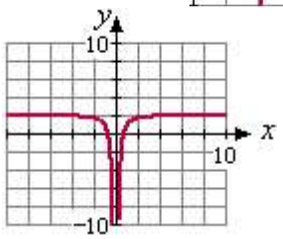


71a.



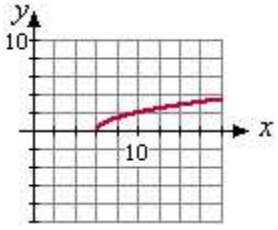
b. Domain: $(-\infty, \infty)$, range: $(-\infty, 9]$

73a.



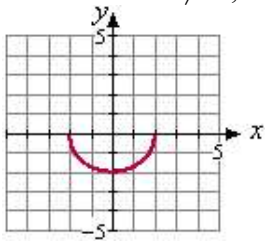
b. Domain: $x \neq 0$, range: $(-\infty, 2)$

75a.



b. Domain: $(6, \infty]$, range: $[0, \infty)$

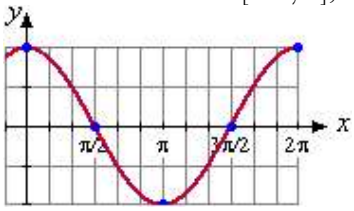
77a.



b. Domain: $[-2, 2]$, range: $[-2, 0]$

79a.

x	0	$\frac{\pi}{2}$	π	$\frac{3\pi}{2}$	2π
$\cos x$	1	0	-1	0	1



b. Domain: $(-\infty, \infty)$, range: $[-1, 1]$

Chapter 6 Review

1a. $\frac{5\pi}{12}$ b. $\frac{7\pi}{6}$ c. $\frac{17\pi}{9}$ 3a. 0.47 b. 2.48 c. 3.80

5a. $150°$ b. $54°$ c. $230°$ 7a. $114.59°$ b. $206.26°$ c. $45.84°$

9a. $\frac{4\pi}{3}$ b. $\frac{7\pi}{6}$ c. $\frac{9\pi}{4}$ 11a. $\frac{1}{8}$ b. $\frac{5}{16}$ c. $\frac{7}{6}$

13a. II b. I c. IV 15a. 0.006, 2.17, 0.0379 b. 0.0379

17a. 6885 mph 19a. 0 b. $\frac{-8}{\sqrt{3}}$ c. $\frac{-1}{2}$

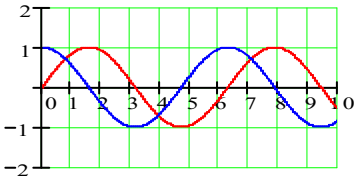
21a. $(0.5, 0.8)$ b. $(-0.4, 0.9)$ c. $(-1.0, 0.1)$

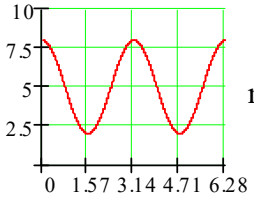
23a. $(r\cos\alpha, r\sin\alpha)$ b. $(-r\cos\alpha, r\sin\alpha)$ c. $(-r\cos\alpha, -r\sin\alpha)$

d. $(r\cos\alpha, -r\sin\alpha)$ 25. 6π 27. $>$ 29. $<$

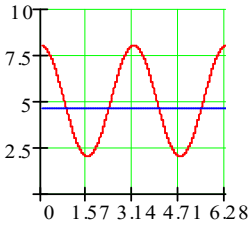
31. 9.86 33. -1.33 35a. $\frac{\pi}{6}$ b. $\frac{\pi}{4}$ c. $\frac{3\pi}{8}$ d. $\frac{5\pi}{12}$

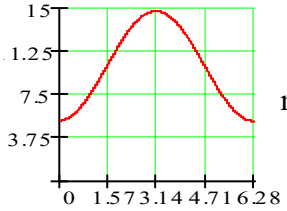
37a. 0.34 b. 0.76 c. 1.25 d. 1.5 39. $158.2°$

41. 

43a. 

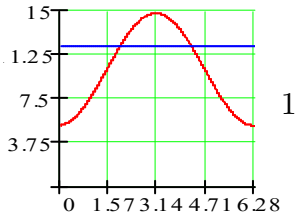
mid: $y = 5$, amp: 3, period: π

b. 

45a. 

mid: $y = 10$, amp: 4.8, period: 2π

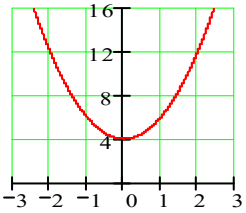
0.86, 2.28, 4.00, 5.42

b. 

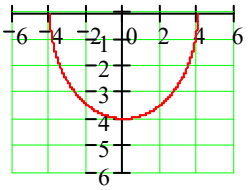
1.93, 4.2 47. $\frac{5\pi}{12}, \frac{17\pi}{12}$ 49. $\frac{\pi}{3}, \frac{2\pi}{3}$ 51. π

53. 1.37, 4.51 55. 6.02, 3.40 57. 0.32, 5.97 59a. 1.21, 5.07

b. 0.9394 61a. 0.40, 2.74 b. 0.3827

63. 

Dom: all real numbers, Rge: $y \geq 4$

65. 

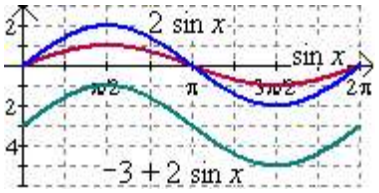
Dom: $-4 \leq x \leq 4$, Rge: $-4 \leq y \leq 0$

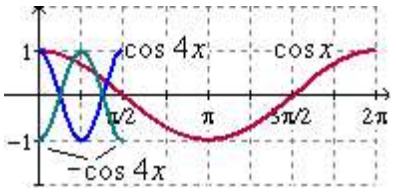
67a. $x^2 + y^2 = 1$ b. $(\cos t, \sin t)$ c. $\cos^2 t + \sin^2 t = 1$ d. Yes

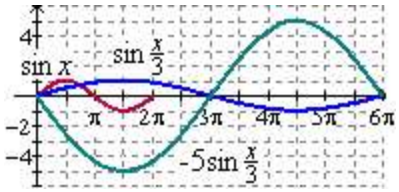
Answers to Odd-Numbered Homework Problems

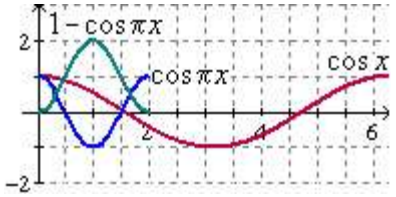
Homework 7.1

1. amplitude 2, period 2π, midline $y = -3$
3. amplitude 1, period $\frac{\pi}{2}$, midline $y = 0$
5. amplitude 5, period 6π, midline $y = 0$
7. amplitude 1, period 2, midline $y = 1$

9. 

11. 

13. 

15. 

17. $y = -2\sin x$
19. $y = -2\cos x$
21. $y = -0.75\cos x$

23a. amplitude 2, period $\frac{2\pi}{3}$, midline $y = 0$ b. $y = -2\sin 3x$

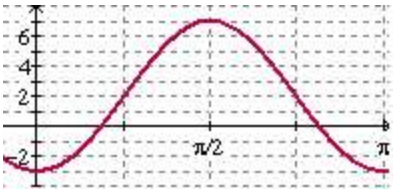
25a. amplitude 3, period 2π, midline $y = 0$ b. $y = 3\sin\frac{x}{2}$

27a. amplitude 0.5, period 4π, midline $y = 3.5$ b. $y = 0.5\cos\frac{x}{2} + 3.5$

29a. amplitude 2, period 4, midline $y = -1$ b. $y = -1 + 2\sin\frac{\pi x}{2}$

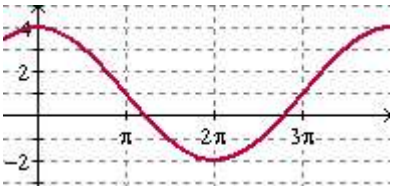
31a.

t	$2t$	$\cos 2t$	$-5\cos 2t$	$2 - 5\cos 2t$
0	0	1	−5	−3
$\frac{\pi}{4}$	$\frac{\pi}{2}$	0	0	2
$\frac{\pi}{2}$	π	−1	5	7
$\frac{3\pi}{4}$	$\frac{3\pi}{2}$	0	0	2
π	2π	1	−5	−3

b. 

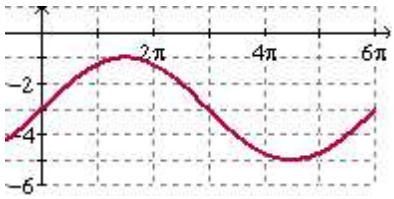
33a.

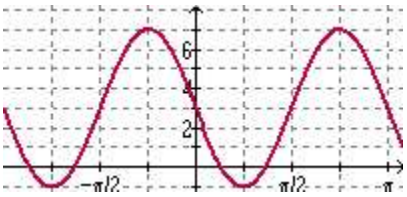
t	$\frac{t}{2}$	$\cos\frac{t}{2}$	$3\cos\frac{t}{2}$	$1 + 3\cos\frac{t}{2}$
0	0	1	3	4
π	$\frac{\pi}{2}$	0	0	1
2π	π	−1	−3	−2
3π	$\frac{3\pi}{2}$	0	0	1
4π	2π	1	3	4

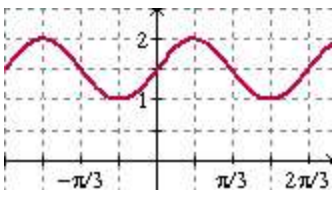
b. 

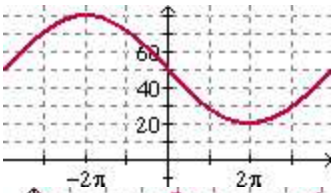
35a.

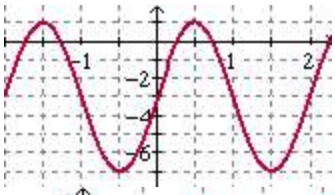
t	$\frac{t}{3}$	$\sin\frac{t}{3}$	$2\sin\frac{t}{3}$	$-3 + 2\sin\frac{t}{3}$
0	0	0	0	−3
$\frac{3\pi}{2}$	$\frac{\pi}{2}$	1	2	−1
3π	π	0	0	−3
$\frac{9\pi}{2}$	$\frac{3\pi}{2}$	−1	−2	−5
6π	2π	0	0	−3

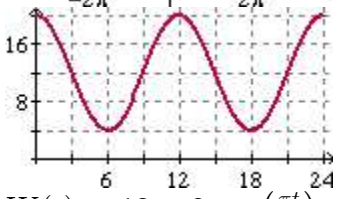
b. 

37. 

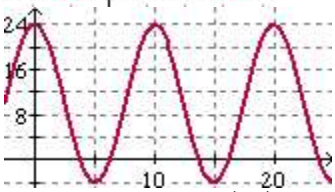
39. 

41. 

43. 

45a. 

b. $W(t) = 12 + 8\cos\left(\frac{\pi t}{6}\right)$

47a. 

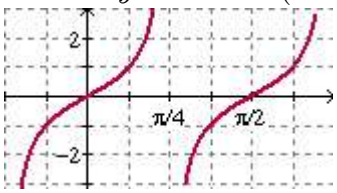
b. $h = 10 + 14\cos\left(\frac{\pi t}{5}\right)$

49. $H = 12 - 2.4\cos\left(\frac{\pi t}{6}\right)$

51. $y = 155\cos(120\,\pi t)$

53.

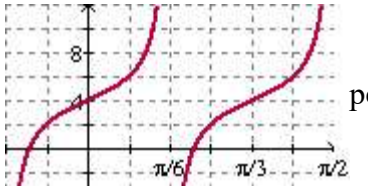
x	$\frac{-\pi}{4}$	$\frac{-\pi}{8}$	0	$\frac{\pi}{8}$	$\frac{\pi}{4}$
$\tan 2x$	undef	-1	0	1	undef



period $\frac{\pi}{2}$, midline $y = 0$

55.

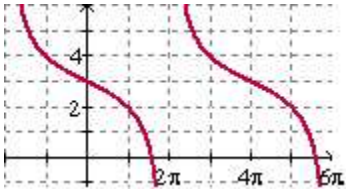
x	$\frac{-\pi}{6}$	$\frac{-\pi}{12}$	0	$\frac{\pi}{12}$	$\frac{\pi}{6}$
$4 + 2\tan 3x$	undef	2	0	6	undef



period $\frac{\pi}{3}$, midline $y = 4$

57.

x	-2π	$-\pi$	0	π	2π
$3 - \tan\frac{x}{4}$	undef	4	0	2	undef



period 4π, midline $y = 3$

59. $\frac{\pi}{12}, \frac{5\pi}{12}, \frac{7\pi}{12}, \frac{11\pi}{12}, \frac{13\pi}{12}, \frac{17\pi}{12}, \frac{19\pi}{12}, \frac{23\pi}{12}$

61. $\frac{7\pi}{12}, \frac{11\pi}{12}, \frac{19\pi}{12}, \frac{23\pi}{12}$

63. $\frac{\pi}{12}, \frac{5\pi}{12}, \frac{3\pi}{4}, \frac{13\pi}{12}, \frac{17\pi}{12}, \frac{7\pi}{4}$

65. 1.83, 2.88, 4.97, 6.02

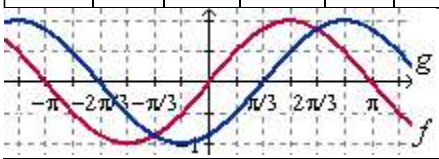
67. 4.19

69. 0.28, 1.81, 2.37, 3.91, 4.47, 6.00

Homework 7.2

1a.

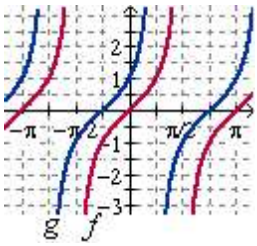
x	$-\pi$	$\frac{-5\pi}{6}$	$\frac{-2\pi}{3}$	$\frac{-\pi}{2}$	$\frac{-\pi}{3}$	$\frac{-\pi}{6}$	0	$\frac{\pi}{6}$	$\frac{\pi}{3}$	$\frac{\pi}{2}$	$\frac{2\pi}{3}$	$\frac{5\pi}{6}$	π
$f(x)$	0	$\frac{-1}{2}$	$\frac{-\sqrt{3}}{2}$	-1	$\frac{-\sqrt{3}}{2}$	$\frac{-1}{2}$	0	$\frac{1}{2}$	$\frac{\sqrt{3}}{2}$	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{2}$	0
$g(x)$	$\frac{\sqrt{3}}{2}$	$\frac{1}{2}$	0	$\frac{-1}{2}$	$\frac{-\sqrt{3}}{2}$	-1	$\frac{-\sqrt{3}}{2}$	$\frac{-1}{2}$	0	$\frac{1}{2}$	$\frac{\sqrt{3}}{2}$	1	$\frac{\sqrt{3}}{2}$

b. 

c. $\frac{\pi}{3}$ to the right d. $\frac{5\pi}{6}$ e. $\frac{-2\pi}{3}, \frac{\pi}{3}$

3a.

x	$-\pi$	$\frac{-3\pi}{4}$	$\frac{-\pi}{2}$	$\frac{-\pi}{4}$	0	$\frac{\pi}{4}$	$\frac{\pi}{2}$	$\frac{3\pi}{4}$	π
$f(x)$	0	1	undef	-1	0	1	undef	-1	0
$g(x)$	1	undef	-1	0	1	undef	-1	0	1

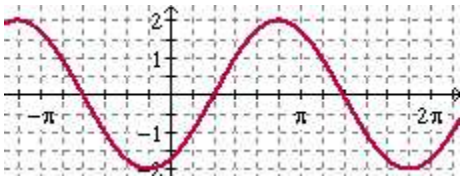
b. 

c. $\frac{\pi}{4}$ to the left d. $-\pi, 0, \pi$ e. $\frac{-\pi}{4}, \frac{3\pi}{4}$

5a. amplitude 2, shift $\frac{\pi}{6}$ to left

b.

x	$x+\frac{\pi}{6}$	$\cos\left(x+\frac{\pi}{6}\right)$	$-2\cos\left(x+\frac{\pi}{6}\right)$
$\frac{-7\pi}{6}$	$-\pi$	-1	2
$\frac{-2\pi}{3}$	$\frac{-\pi}{2}$	0	0
$\frac{-\pi}{6}$	0	1	-2
$\frac{\pi}{3}$	$\frac{\pi}{2}$	0	0
$\frac{5\pi}{6}$	π	-1	2
$\frac{4\pi}{3}$	$\frac{3\pi}{2}$	0	0
$\frac{11\pi}{6}$	2π	1	-2

c. 

d. $\frac{\pi}{2}, \frac{7\pi}{6}$ e. $\frac{\pi}{3}, \frac{4\pi}{3}$

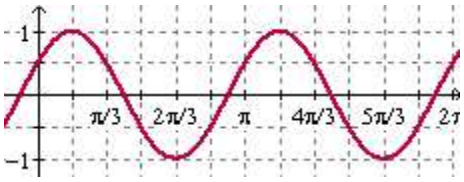
7a. $f(x) = \sin(x+\frac{\pi}{4})$ b. $f(x) = \cos(x-\frac{\pi}{4})$

9a. $f(x) = \tan\left(x-\frac{\pi}{3}\right)$ b. $f(x) = \tan\left(x+\frac{2\pi}{3}\right)$

11a. period π, shift $\frac{\pi}{6}$ right

b.

x	$2x$	$2x-\frac{\pi}{3}$	$\cos\left(2x-\frac{\pi}{3}\right)$
$\frac{\pi}{6}$	$\frac{\pi}{3}$	0	1
$\frac{5\pi}{12}$	$\frac{5\pi}{6}$	$\frac{\pi}{2}$	0
$\frac{2\pi}{3}$	$\frac{4\pi}{3}$	π	-1
$\frac{11\pi}{12}$	$\frac{11\pi}{6}$	$\frac{3\pi}{2}$	0
$\frac{7\pi}{6}$	$\frac{7\pi}{3}$	2π	1

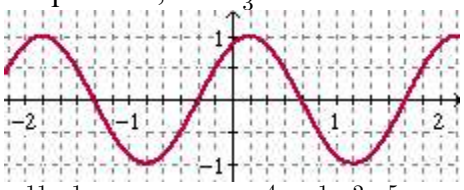
c. 

d. $\frac{\pi}{6}, \frac{7\pi}{6}$ e. $\frac{5\pi}{12}, \frac{11\pi}{12}, \frac{13\pi}{6}, \frac{23\pi}{12}$

13a. period 2, shift $\frac{1}{3}$ left

b.

x	πx	$\pi x+\frac{\pi}{3}$	$\sin\left(\pi x+\frac{\pi}{3}\right)$
$\frac{-1}{3}$	$\frac{-\pi}{3}$	0	0
$\frac{1}{6}$	$\frac{\pi}{6}$	$\frac{\pi}{2}$	1
$\frac{2}{3}$	$\frac{2\pi}{3}$	π	0
$\frac{7}{6}$	$\frac{7\pi}{6}$	$\frac{3\pi}{2}$	-1
$\frac{5}{3}$	$\frac{5\pi}{3}$	2π	0

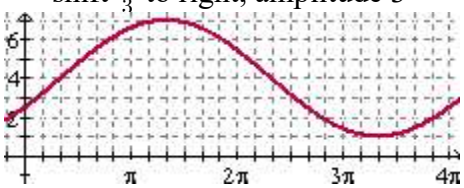
c. 

d. $\frac{-11}{6}, \frac{1}{6}$ e. $\frac{-4}{3}, \frac{-1}{3}, \frac{2}{3}, \frac{5}{3}$

15a. midline $y=4$, period 4π, horizontal shift $\frac{\pi}{3}$ to right, amplitude 3

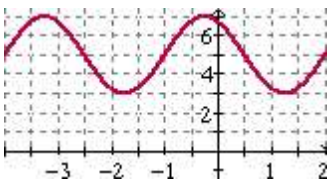
b.

x	$\frac{x}{2}$	$\frac{x}{2}-\frac{\pi}{6}$	$\sin\left(\frac{x}{2}-\frac{\pi}{6}\right)$	$3\sin\left(\frac{x}{2}-\frac{\pi}{6}\right)+4$
$\frac{\pi}{3}$	$\frac{\pi}{6}$	0	0	4
$\frac{4\pi}{3}$	$\frac{2\pi}{3}$	$\frac{\pi}{2}$	1	7
$\frac{7\pi}{3}$	$\frac{7\pi}{6}$	π	0	3
$\frac{10\pi}{3}$	$\frac{5\pi}{3}$	$\frac{3\pi}{2}$	-1	1
$\frac{13\pi}{3}$	$\frac{13\pi}{6}$	2π	0	4

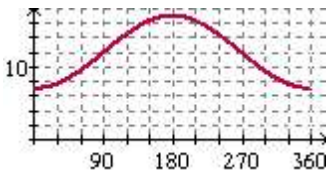
c. 

d. no solution for $0 \le x \le 2\pi$ e. $\frac{\pi}{3}$

17. $y = 2\sin\left(\frac{2\pi}{3}(x+4)\right)+5$



19. $y = -5\cos\left(\frac{\pi x}{180}\right)+12$

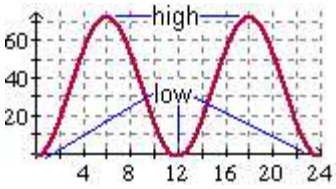


21a. $f(x) = 3\sin\left(x + \frac{2\pi}{3}\right)$ b. $f(x) = 3\cos\left(x + \frac{\pi}{6}\right)$

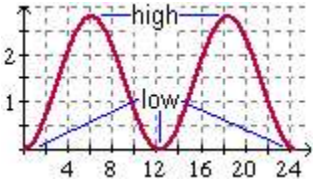
23a. $f(x) = 2\sin(2(x - \frac{\pi}{4}))$ b. $f(x) = -2\cos(2x)$

25a. $f(x) = 4\sin\left(\frac{1}{4}\left(x - \frac{7\pi}{3}\right)\right)$ b. $f(x) = -4\cos\left(\frac{1}{4}\left(x - \frac{\pi}{3}\right)\right)$

27a. midline $T = 35.35$, period 12, amplitude 36.95

b. $T(m) = -36.95\cos\left(\frac{\pi}{6}m\right) + 35.35$ c. 

29a. midline $h = 1.4$, period $\frac{2\pi}{0.51} \approx 12.32$, amplitude 1.4

b. 

c. high 11:10 am, low 5:19 pm

31a. amplitude 3.2, period 2, midline $y = 2$ b. $f(t) = 2 + 3.2\cos(\pi t)$

33a. amplitude 5, period 1, midline $y = 0$ b. $H(x) = 5\sin(2\pi x) + 5$

Homework 7.3

1b. $\frac{3\pi}{8}, \frac{7\pi}{8}, \frac{11\pi}{8}, \frac{15\pi}{8}$ 3b. $0, \frac{\pi}{2}, \pi, \frac{3\pi}{2}, 2\pi$ 5b. $\frac{2\pi}{9}, \frac{4\pi}{9}, \frac{8\pi}{9}, \frac{10\pi}{9}, \frac{14\pi}{9}, \frac{16\pi}{9}$

7b. $\frac{\pi}{12}, \frac{5\pi}{12}, \frac{13\pi}{12}, \frac{17\pi}{12}$ 9b. $\frac{\pi}{18}, \frac{7\pi}{18}, \frac{13\pi}{18}, \frac{19\pi}{18}, \frac{25\pi}{18}, \frac{31\pi}{18}$ 11. 0.491, 2.651, 3.632, 5.792

13. 0.540, 1.325, 2.110, 2.896, 3.681, 4.467, 5.252, 6.037

15. 1.114, 2.027, 3.209, 4.122, 5.303, 6.216 17. 0.702, 2.440, 3.843, 5.582

19. 0, 1, 2, 3, 4, 5, 6 21. $\frac{\pi}{6}, \frac{2\pi}{3}, \frac{7\pi}{6}, \frac{5\pi}{3}$ 23. $\frac{5\pi}{12}, \frac{7\pi}{12}, \frac{13\pi}{12}, \frac{5\pi}{4}, \frac{7\pi}{4}, \frac{23\pi}{12}$ 25. $\frac{3\pi}{2}$

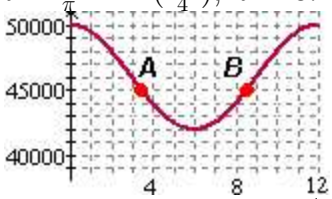
27. $\frac{7}{6}, \frac{11}{6}, \frac{19}{6}, \frac{23}{6}, \frac{31}{6}, \frac{35}{6}$ 29. 1.14, 1.62, 3.23, 3.72, 5.24, 5.81

31. 0.44, 1.44, 2.44, 3.44, 4.44, 5.44 33. 0.01, 3.39, 6.01

35. 0.564, 1.182, 2.658, 3.276, 4.752, 5.371 37. 0.423, 2.977, 4.423

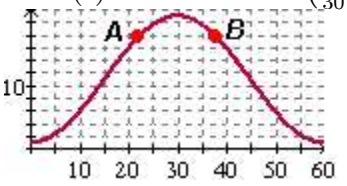
39. 1.165, 4.165 41. 2.251 43a. $P(t) = 4000\cos\left(\frac{\pi}{6}t\right) + 46,000$

b. $t = \frac{6}{\pi}\cos^{-1}(\frac{-1}{4})$; $t = 3.48$ months (Dec) or $t = 8.52$ months (June)

c. 

$P(t)$ is less than 45,000 between A and B.

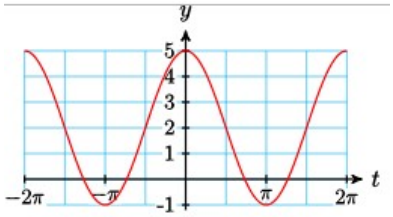
45a. $h(t) = 11 - 10\cos\left(\frac{\pi}{30}t\right)$ b. $t = \frac{30}{\pi}\cos^{-1}(\frac{-7}{10})$; $t = 22.40$ sec or $t = 37.60$ sec

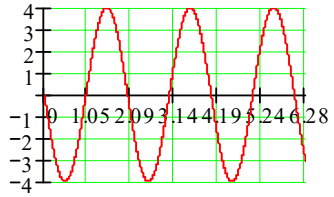
c. 

Delbert is above 18 m between A and B.

Chapter 7 Review

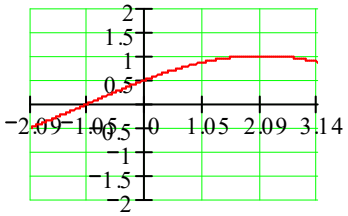
1. amp: 2, period: $\frac{2\pi}{3}$, mid: $y = 4$ 3. amp: 2.5, period: 2, mid: $y = -2$

5. 

7. 

9. $y = 3 + 2\sin x$ 11. $y = 4 - 3\sin\frac{x}{4}$

13a. period: 4π, shift: $\frac{\pi}{3}$ left

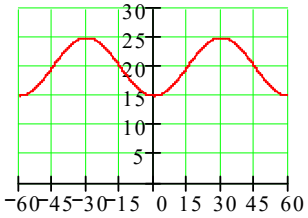
c. 

d. $\frac{2\pi}{3}$ d. $\frac{-\pi}{3}$

b.

x	$\frac{x}{2}$	$\frac{x}{2}+\frac{\pi}{6}$	$\sin\left(\frac{x}{2}+\frac{\pi}{6}\right)$
$\frac{-2\pi}{3}$	$\frac{-\pi}{3}$	$\frac{-\pi}{6}$	$\frac{-1}{2}$
$\frac{-\pi}{3}$	$\frac{-\pi}{6}$	0	0
0	0	$\frac{\pi}{6}$	$\frac{1}{2}$
$\frac{\pi}{6}$	$\frac{\pi}{12}$	$\frac{\pi}{4}$	$\frac{1}{\sqrt{2}}$
$\frac{\pi}{3}$	$\frac{\pi}{6}$	$\frac{\pi}{3}$	$\frac{\sqrt{3}}{2}$
$\frac{2\pi}{3}$	$\frac{\pi}{3}$	$\frac{\pi}{2}$	1
π	$\frac{\pi}{2}$	$\frac{2\pi}{3}$	$\frac{\sqrt{3}}{2}$

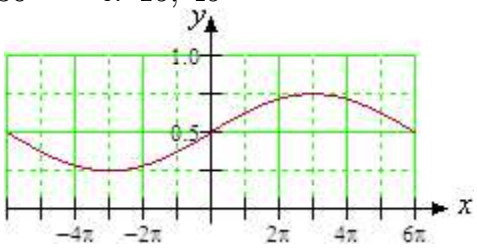
15a. mid: $y = 20$, period: 60, amp: 5

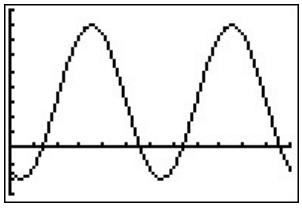
c. 

d. 30 e. 15, 45

b.

x	$\frac{\pi}{30}x$	$\cos\left(\frac{\pi}{30}x\right)$	$20 - 5\cos\left(\frac{\pi}{30}x\right)$
-5	$\frac{-\pi}{6}$	$\frac{\sqrt{3}}{2}$	$20 - \frac{5\sqrt{3}}{2}$
0	0	1	15
5	$\frac{\pi}{6}$	$\frac{\sqrt{3}}{2}$	$20 - \frac{5\sqrt{3}}{2}$
10	$\frac{\pi}{3}$	$\frac{1}{2}$	17.5
15	$\frac{\pi}{2}$	0	20
30	π	-1	25

17. 

19a. 

b. 0.57, 3.07, 3.71

21. $y = 85.5 - 19.5\cos\frac{\pi}{6}t$ 23a. amp: 3, period: 12, midline: $y = 15$ b. $y = 15 - 3\cos\frac{\pi}{6}t$

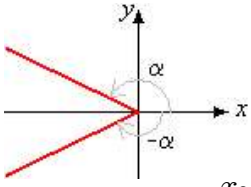
25. $\frac{7\pi}{12}, \frac{11\pi}{12}, \frac{19\pi}{12}, \frac{23\pi}{12}$ 27. $0, \frac{\pi}{4}, \frac{\pi}{2}, \frac{3\pi}{4}, \pi, \frac{5\pi}{4}, \frac{3\pi}{2}, \frac{7\pi}{4}$

29. 0.066, 1.113, 2.160, 3.207, 4.255, 5.302 31. 1.150, 1.991, 4.292, 5.133

33. $\frac{\pi}{24}, \frac{5\pi}{24}, \frac{25\pi}{24}, \frac{29\pi}{24}$ 35. No solution

37. 0.375, 1.422, 2.470, 3.517, 4.564, 5.611 39. 2.120, 4.880

Homework 8.1

1. 

$x_2 = x_1$, $y_2 = -y_1$, and $r_2 = r_1$

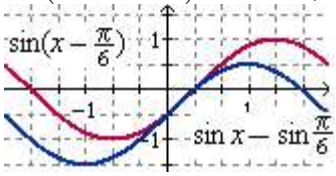
Thus, $\cos(-\alpha) = \dfrac{x_2}{r_2} = \dfrac{x_1}{r_1} = \cos\alpha$, $\sin(-\alpha) = \dfrac{y_2}{r_2} = \dfrac{-y_1}{r_1} = -\sin\alpha$, and

$\tan(-\alpha) = \dfrac{y_2}{x_2} = \dfrac{-y_1}{x_1} = -\tan\alpha$

3. $\frac{-\left(\sqrt{2}+\sqrt{6}\right)}{4}$ 5. $\cos(0.3 - 2x) = 0.24$, $\sin(0.3 - 2x) = 0.97$

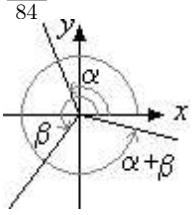
7. $\cos(45° + 45°) = \cos(90°) = 0$, but $\cos 45° + \cos 45° = \frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}} = \sqrt{2}$

9. $\tan(87° - 29°) \approx 1.600$, but $\tan 87° - \tan 29° \approx 18.527$

11. 

The curves are different. 13a. $\frac{63}{65}$ b. $\frac{-16}{65}$ c. $\frac{-16}{63}$

15a. $\frac{44}{117}$ b. $\frac{4}{3}$ 17a. $\frac{36}{85}$ b. $\frac{-13}{84}$

19a. $\frac{-16}{65}$ b. $\frac{63}{65}$ c. $\frac{-16}{63}$ d. 

21. $\cos 15° = \frac{\sqrt{6}+\sqrt{2}}{4}$, $\tan 15° = 2 - \sqrt{3}$ 23. $\frac{6\sqrt{2}+1}{10}$ 25. $\cos\theta$

27. $\frac{\sqrt{3}}{2}\cos t - \frac{1}{2}\sin t$ 29. $\frac{\sqrt{3}\tan\beta - 1}{\sqrt{3}+\tan\beta}$ 31. No 33. No

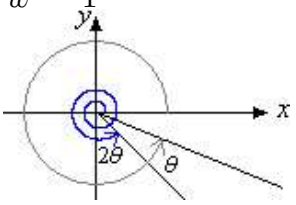
35. $1 = 2\left(\frac{1}{\sqrt{2}}\right)\left(\frac{1}{\sqrt{2}}\right)$ 37. $\frac{1}{2} = \left(\frac{\sqrt{3}}{2}\right)^2 - \left(\frac{1}{2}\right)^2$ 39. False, but $\cos 2\alpha = 2(0.32)^2 - 1$

41. False, but $2\theta = \sin^{-1}(h)$ 43. $\sin 68°$ 45. $\cos\frac{\pi}{8}$ 47. $\cos 6\theta$ 49. $\sin 10t$

51. $\tan 128°$ 53. $\cos 4\beta$ 55a. $\frac{5}{6}$ b. $\frac{\sqrt{11}}{6}$ c. $\frac{5}{\sqrt{11}}$ d. $\frac{5\sqrt{11}}{18}$

e. $\frac{-7}{18}$ f. $\frac{-5\sqrt{11}}{7}$ 57a. $\frac{1}{\sqrt{w^2+1}}$ b. $\frac{w}{\sqrt{w^2+1}}$ c. $\frac{1}{w}$

d. $\frac{2w}{w^2+1}$ e. $\frac{w^2-1}{w^2+1}$ f. $\frac{2w}{w^2-1}$

59a. $\frac{-5}{13}$ b. $\frac{-120}{169}$ c. $\frac{119}{169}$ d. $\frac{-120}{119}$ e. 

61a. $\frac{8}{15}$ b. $\frac{-15}{17}$ c. $\frac{-8}{17}$

63a. $2\sin\theta\cos\theta + \sqrt{2}\cos\theta = 0$ b. $\frac{\pi}{2}, \frac{5\pi}{4}, \frac{3\pi}{2}, \frac{7\pi}{4}$

65a. $2\cos^2 t - 5\cos t + 2 = 0$ b. $\frac{\pi}{3}, \frac{5\pi}{3}$

67a. $\frac{2\tan\beta}{1-\tan^2\beta} + 2\sin\beta = 0$ b. $0, \frac{\pi}{3}, \pi, \frac{5\pi}{3}$

69a. $3\cos\phi - \cos\phi = \sqrt{3}$ b. $\frac{\pi}{6}, \frac{11\pi}{6}$

71a. $\sin 3\phi = 1$ b. $\frac{\pi}{6}, \frac{5\pi}{6}, \frac{3\pi}{2}$

73a. $\cos(\theta + 90°) = -\sin\theta$ b. $\sin(\theta + 90°) = \cos\theta$

75a. $\cos\left(\frac{\pi}{2} - \theta\right) = \cos\frac{\pi}{2}\cos\theta + \sin\frac{\pi}{2}\sin\theta = \sin\theta$

b. $\sin\left(\frac{\pi}{2} - \theta\right) = \sin\frac{\pi}{2}\cos\theta - \cos\frac{\pi}{2}\sin\theta = \cos\theta$

77. $\sin 2\theta = \sin(\theta + \theta) = \sin\theta\cos\theta + \cos\theta\sin\theta = 2\sin\theta\cos\theta$

79a. Not an identity b. $\beta = \pi$ (many answers possible) 81. Identity

83a. Not an identity b. $\theta = 0$ (many answers possible) 85. Identity 87. Identity

89a. $l_1 = \sin\alpha,\ l_2 = \cos\alpha$ b. θ_1 and β are both complements of ϕ, θ_2 and $\alpha + \beta$ are alternate interior angles c. $s_1 = \cos(\alpha + \beta),\ s_2 = \sin(\alpha + \beta)$

d. $s_3 = \sin\alpha\sin\beta$, $s_4 = \sin\alpha\cos\beta$ e. $s_5 = \cos\alpha\cos\beta,\ s_6 = \cos\alpha\sin\beta$

f. $\sin(\alpha + \beta) = \sin\alpha\cos\beta + \cos\alpha\sin\beta,\ \cos(\alpha + \beta) + \sin\alpha\sin\beta = \cos\alpha\cos\beta$

91a. $(AB)^2 = 2 - 2\cos(\alpha - \beta)$ b. $(AB)^2 = (\cos\alpha - \cos\beta)^2 + (\sin\alpha - \sin\beta)^2$

c. $2 - 2\cos(\alpha - \beta) = (\cos\alpha - \cos\beta)^2 + (\sin\alpha - \sin\beta)^2$

$2 - 2\cos(\alpha - \beta) = \cos^2\alpha - 2\cos\alpha\cos\beta + \cos^2\beta + \sin^2\alpha - 2\sin\alpha\sin\beta + \sin^2\beta$

$2 - 2\cos(\alpha - \beta) = \cos^2\alpha + \sin^2\alpha + \cos^2\beta + \sin^2\beta - 2\cos\alpha\cos\beta - 2\sin\alpha\sin\beta$

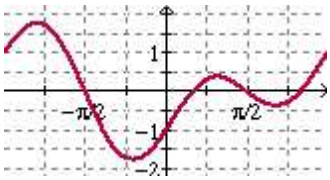
$2 - 2\cos(\alpha - \beta) = 1 + 1 - 2(\cos\alpha\cos\beta + \sin\alpha\sin\beta)$

$-2\cos(\alpha - \beta) = -2(\cos\alpha\cos\beta + \sin\alpha\sin\beta)$

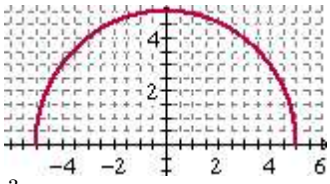
$\cos(\alpha - \beta) = \cos\alpha\cos\beta + \sin\alpha\sin\beta$

Homework 8.2

1. No inverse: Some horizontal lines intersect the curve in more than one point.
3. Inverse exists: The function is 1-1.

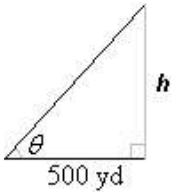
5. 

No inverse

7. 

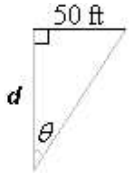
No inverse

9. $16.5°$ 11. $46.4°$ 13. $-51.9°$ 15. $\frac{3\pi}{4}$ 17. $\frac{-\pi}{6}$ 19. $\frac{\pi}{6}$

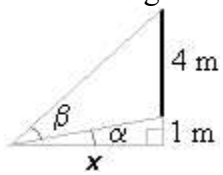
21. 

a. $h = 500\tan\theta$ b. $\theta = \tan^{-1}\left(\frac{h}{500}\right)$

c. $\theta = \tan^{-1}(2)$, so the angle of elevation is $\tan^{-1}2 \approx 63.4°$ when the rocket is 1000 yd high.

23. 

a. $d = \frac{50}{\tan\theta}$ b. $\theta = \tan^{-1}\left(\frac{50}{d}\right)$ c. $\theta = \tan^{-1}(0.25)$; the billboard subtends an angle of $\tan^{-1}(0.25) \approx 14°$ at a distance of 200 ft.

25. 

a. $\alpha = \tan^{-1}\left(\frac{1}{x}\right)$ b. $\beta = \tan^{-1}\left(\frac{5}{x}\right) - \tan^{-1}\left(\frac{1}{x}\right)$

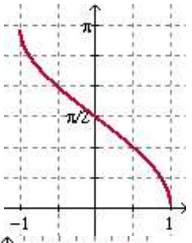
c. $\beta = 45° - \tan^{-1}\left(\frac{1}{5}\right)$, so the painting subtends an angle of $45° - \tan^{-1}\left(\frac{1}{5}\right) \approx 33.7°$ when Martin is 5 meters from the wall.

27. $t = \frac{1}{2\pi\omega}\left(\sin^{-1}\frac{V}{V_0} - \phi\right)$ 29. $A = \sin^{-1}\left(\frac{a\sin B}{b}\right)$ 31. $\theta = \pm\cos^{-1}\left(\frac{k}{PR^4}\right)$

33. $\frac{2}{\sqrt{5}}$ 35. $\frac{1}{\sqrt{5}}$ 37. $\frac{5}{7}$ 39. $\frac{\sqrt{1-x^2}}{x}$ 41. $\sqrt{1-h^2}$ 43. $\frac{2t}{\sqrt{4t^2+1}}$

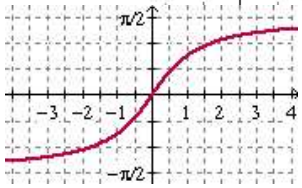
45.

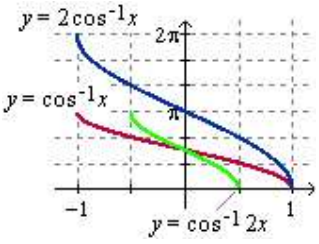
x	-1	$\frac{-\sqrt{3}}{2}$	$\frac{-\sqrt{2}}{2}$	$\frac{-1}{2}$	0	$\frac{1}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$	1
$\cos^{-1}x$	π	$\frac{5\pi}{6}$	$\frac{3\pi}{4}$	$\frac{2\pi}{3}$	$\frac{\pi}{2}$	$\frac{\pi}{3}$	$\frac{\pi}{4}$	$\frac{\pi}{6}$	0



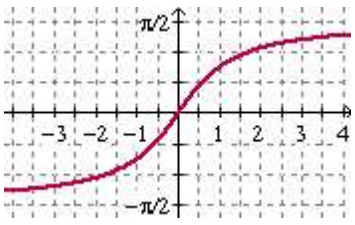
47.

x	$-\sqrt{3}$	-1	$\frac{-1}{\sqrt{3}}$	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$
$\tan^{-1}x$	$\frac{-\pi}{3}$	$\frac{-\pi}{4}$	$\frac{-\pi}{6}$	0	$\frac{\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$



49a–b. 

c. No

51a. 

c. No

53. $\frac{8}{17}$ 55. $-3\sqrt{7}$ 57. $\frac{4\sqrt{2}}{7}$

59a. $\frac{-63}{65}$ b. $\frac{16}{65}$ c. $\frac{-33}{65}$ d. $\frac{56}{65}$

61. 1 63a. $\dfrac{2x}{x^2+1}$ b. $1-2x^2$

65. $\sin 2\theta = \dfrac{2x\sqrt{25-x^2}}{25}$, $\cos 2\theta = \dfrac{25-2x^2}{25}$ 67. $\arctan\dfrac{x}{3} + \dfrac{3x}{2(x^2+9)}$

69a. $-1 \le x \le 1$ b. Yes. c. All d. $x < \frac{-\pi}{2}$ or $x > \frac{\pi}{2}$

71a. Domain: $-1 \le x \le 1$, range: $\{\frac{\pi}{2}\}$

b. The function is a constant because $\cos\theta = \sin(\frac{\pi}{2} - \theta)$.

73a. $\frac{\theta}{2}$ b. $t = \sin\theta$ c. $\frac{1}{2}\arcsin t$

Homework 8.3

1. 2.203 3. 0.466 5. 5.883 7. 1.203

9. 2 11. 1 13. $\frac{-2\sqrt{3}}{3}$ 15. $\sqrt{2}$

17.

θ	0	$\frac{\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$	$\frac{\pi}{2}$	$\frac{2\pi}{3}$	$\frac{3\pi}{4}$	$\frac{5\pi}{6}$	π
$\sec\theta$	1	$\frac{2\sqrt{3}}{3}$	$\sqrt{2}$	2	undef.	-2	$-\sqrt{2}$	$\frac{-2\sqrt{3}}{3}$	-1
$\csc\theta$	undef.	2	$\sqrt{2}$	$\frac{2\sqrt{3}}{3}$	1	$\frac{2\sqrt{3}}{3}$	$\sqrt{2}$	2	undef.
$\cot\theta$	undef.	$\sqrt{3}$	1	$\frac{\sqrt{3}}{3}$	0	$\frac{-\sqrt{3}}{3}$	-1	$-\sqrt{3}$	undef.

19. a. 0.980 b. 1.020 c. 1.369
d. 1.020 e. 0.284 f. 1.020

21. $\sin\theta = \frac{4}{5}$,$\cos\theta = \frac{3}{5}$, $\tan\theta = \frac{4}{3}$, $\sec\theta = \frac{5}{3}$, $\csc\theta = \frac{5}{4}$, $\cot\theta = \frac{3}{4}$

23. $\sin\theta = \frac{4}{\sqrt{41}}$,$\cos\theta = \frac{5}{\sqrt{41}}$, $\tan\theta = \frac{4}{5}$, $\sec\theta = \frac{\sqrt{41}}{5}$, $\csc\theta = \frac{\sqrt{41}}{4}$, $\cot\theta = \frac{5}{4}$

25. $\sin\theta = \frac{5}{\sqrt{74}}$,$\cos\theta = \frac{-7}{\sqrt{74}}$, $\tan\theta = \frac{-5}{7}$, $\sec\theta = \frac{-\sqrt{74}}{7}$, $\csc\theta = \frac{\sqrt{74}}{5}$, $\cot\theta = \frac{-7}{5}$

27. $\sin\theta = \frac{-5}{8}$,$\cos\theta = \frac{\sqrt{39}}{8}$, $\tan\theta = \frac{5}{\sqrt{39}}$, $\sec\theta = \frac{-8}{\sqrt{39}}$, $\csc\theta = \frac{-8}{5}$, $\cot\theta = \frac{\sqrt{39}}{5}$

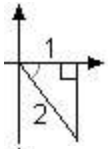
29a. $d = h\csc\theta$ b. 155.572 mi 31a. 0.78 sec b. $l = 8t^2\sin 2\theta$

33. $\sin\theta = \dfrac{7}{\sqrt{x^2+49}}$,$\cos\theta = \dfrac{x}{\sqrt{x^2+49}}$, $\tan\theta = \dfrac{7}{x}$, $\sec\theta = \dfrac{\sqrt{x^2+49}}{x}$, $\csc\theta = \dfrac{\sqrt{x^2+49}}{7}$,
$\cot\theta = \dfrac{x}{7}$

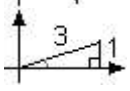
35. $\sin\theta = S$,$\cos\theta = \sqrt{1-S^2}$, $\tan\theta = \dfrac{S}{\sqrt{1-S^2}}$, $\sec\theta = \dfrac{1}{\sqrt{1-S^2}}$, $\csc\theta = \dfrac{1}{S}$,
$\cot\theta = \dfrac{\sqrt{1-S^2}}{S}$

37. $\sin\theta = \dfrac{-\sqrt{9-a^2}}{3}$,$\cos\theta = \dfrac{a}{3}$, $\tan\theta = \dfrac{-\sqrt{9-a^2}}{a}$, $\sec\theta = \dfrac{3}{a}$, $\csc\theta = \dfrac{-3}{\sqrt{9-a^2}}$,
$\cot\theta = \dfrac{-a}{\sqrt{9-a^2}}$

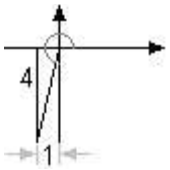
39. AC, OA, BD, OD, OE, EF

41. 

$\sin\theta = \frac{-\sqrt{3}}{2}$,$\cos\theta = \frac{1}{2}$, $\tan\theta = -\sqrt{3}$, $\sec\theta = 2$, $\csc\theta = \frac{-2\sqrt{3}}{3}$, $\cot\theta = \frac{-\sqrt{3}}{3}$

43. 

$\sin\alpha = \frac{1}{3}$,$\cos\alpha = \frac{2\sqrt{2}}{3}$, $\tan\alpha = \frac{\sqrt{2}}{4}$, $\sec\alpha = \frac{3\sqrt{2}}{4}$, $\csc\alpha = 3$, $\cot\alpha = 2\sqrt{2}$

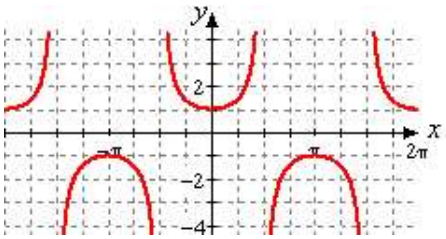
45. 

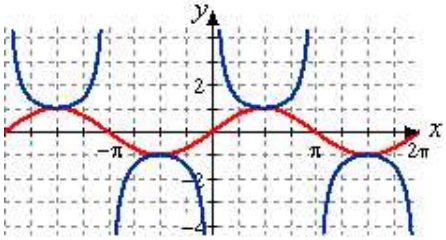
$\sin\gamma = \frac{-4}{\sqrt{17}}, \cos\gamma = \frac{-1}{\sqrt{17}}, \tan\gamma = 4, \sec\gamma = -\sqrt{17}, \csc\gamma = \frac{-\sqrt{17}}{4}, \cot\gamma = \frac{1}{4}$

47. $\frac{4\sqrt{3}}{3} + 2\sqrt{2}$ 49. $\frac{\sqrt{3}}{3}$ 51. $\frac{4\sqrt{6}}{3} + \frac{10}{3}$

53.

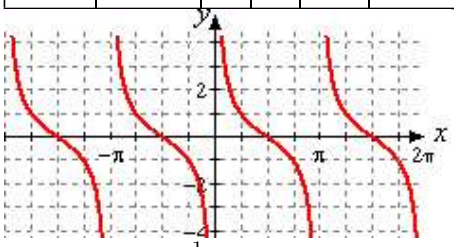
x	0	$\frac{\pi}{4}$	$\frac{\pi}{2}$	$\frac{3\pi}{4}$	π	$\frac{5\pi}{4}$	$\frac{3\pi}{2}$	$\frac{7\pi}{4}$	2π
$\sec x$	1	$\sqrt{2}$	undef.	$-\sqrt{2}$	-1	$-\sqrt{2}$	undef.	$\sqrt{2}$	1



55. 

57.

x	0	$\frac{\pi}{4}$	$\frac{\pi}{2}$	$\frac{3\pi}{4}$	π	$\frac{5\pi}{4}$	$\frac{3\pi}{2}$	$\frac{7\pi}{4}$	2π
$\cot x$	undef.	1	0	-1	undef.	1	0	-1	undef.



59b. $\frac{\csc x}{\cot x} = \frac{\frac{1}{\sin x}}{\frac{\cos x}{\sin x}} = \frac{1}{\sin x} \div \frac{\cos x}{\sin x} = \frac{1}{\sin x} \cdot \frac{\sin x}{\cos x} = \frac{1}{\cos x} = \sec x$

61b. $\frac{\sec x \cot x}{\csc x} = \frac{\frac{1}{\cos x} \cdot \frac{\cos x}{\sin x}}{\frac{1}{\sin x}} = \frac{\frac{1}{\sin x}}{\frac{1}{\sin x}} = 1$

63b. $\tan x \csc x = \frac{\sin x}{\cos x} \cdot \frac{1}{\sin x} = \frac{1}{\cos x} = \sec x$

65. $\frac{\pi}{6}, \frac{5\pi}{6}$ 67. $\frac{3\pi}{4}, \frac{5\pi}{4}$ 69. $\frac{5\pi}{6}, \frac{11\pi}{6}$

71. $\frac{-\sqrt{5}}{5}$ 73. $\frac{\sqrt{a^2-4}}{2}$ 75. $\frac{\sqrt{w^2-1}}{-w}$

77. $\sec s = \frac{-5}{4}, \csc s = \frac{5}{3}, \cot s = \frac{-4}{3}$

79. $\sec s = \frac{1}{\sqrt{1-w^2}}, \csc s = \frac{1}{w}, \cot s = \frac{\sqrt{1-w^2}}{w}$

81. $\frac{\sin\theta}{\cos^2\theta}$ 83. $\sec t$ 85. $\frac{1-\sin\beta}{\cos\beta}$ 87. $-\cos x$

89. $\cos^2\theta + \sin^2\theta = 1$ We divide by $\cos^2\theta$ on both sides of the equation.

$\frac{\cos^2\theta}{\cos^2\theta} + \frac{\sin^2\theta}{\cos^2\theta} = \frac{1}{\cos^2\theta}$ Rewrite each fraction.

$1 + \tan^2\theta = \sec^2\theta$

91a. $\csc\theta = -\sqrt{26}$ b. $\sin\theta = \frac{-\sqrt{26}}{26}, \cos\theta = \frac{-5\sqrt{26}}{26}, \tan\theta = \frac{1}{5}, \sec\theta = \frac{-\sqrt{26}}{5}$

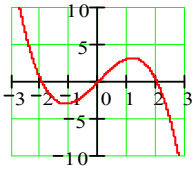
93. $\cos t = \pm\sqrt{1-\sin^2 t}$, $\tan t = \dfrac{\pm\sin t}{\sqrt{1-\sin^2 t}}$, $\sec t = \dfrac{\pm 1}{\sqrt{1-\sin^2 t}}$, $\csc t = \dfrac{1}{\sin t}$,
$\cot t = \dfrac{\pm\sqrt{1-\sin^2 t}}{\sin t}$

95. $\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$
$a \cdot \dfrac{1}{\sin A} = b \cdot \dfrac{1}{\sin B} = c \cdot \dfrac{1}{\sin C}$
$a \csc A = b \csc B = c \csc C$

Chapter 8 Review

1. False 3. True 5. False 7. False 9. $\dfrac{2-\sqrt{21}}{5\sqrt{2}}$ 11a. $\dfrac{5\sqrt{33}-3}{32}$

b. $\dfrac{5\sqrt{33}-3}{\sqrt{5}(3\sqrt{3}+\sqrt{11})}$ 13. 1 15. $\dfrac{\tan t + \sqrt{3}}{1-\sqrt{3}\tan t}$ 17a. $\frac{4}{5}$ b. $\frac{3}{5}$ c. $\frac{4}{3}$ d. $\frac{24}{25}$
e. $\frac{-7}{25}$ f. $\frac{-24}{7}$ 19. $\sin 9x$ 21. $\tan(2\phi - 2)$ 23. $\sin 8\theta$

25a. $1 - 2\sin^2\theta - \sin\theta = 1$ b. $0, \pi, \frac{7\pi}{6}, \frac{11\pi}{6}$ 27.  No

29a. $\frac{-\pi}{3}$ b. $\frac{2\pi}{3}$ 31a. $\tan^{-1}\left(\dfrac{52.8}{x}\right)$ b. $69.25°,\ 27.83°$ 33. $\theta = \sin^{-1}\left(\dfrac{v_y + gt}{v_0}\right)$

35. $\frac{2}{3}$ 37. $\sqrt{1-4t^2}$ 39. Because $|\sin\theta| \le 1$, $\sin^{-1} t$ is undefined for $|t| > 1$. If $x \neq 0$, then either $|x| > 1$ or $\left|\frac{1}{x}\right| > 1$. If $x = 0$, then $\frac{1}{x}$ is undefined.

41. a. 2.203 b. −3.236 c. 0.466

43. $\sin\theta = \frac{13}{\sqrt{313}}$, $\cos\theta = \frac{12}{\sqrt{313}}$, $\tan\theta = \frac{13}{12}$, $\sec\theta = \frac{\sqrt{313}}{12}$, $\csc\theta = \frac{\sqrt{313}}{13}$, $\cot\theta = \frac{12}{13}$

45. $\sin\theta = \frac{1}{3}$, $\cos\theta = \frac{-2\sqrt{2}}{3}$, $\tan\theta = \frac{-1}{2\sqrt{2}}$, $\sec\theta = \frac{-3}{2\sqrt{2}}$, $\csc\theta = 3$, $\cot\theta = -2\sqrt{2}$

47. $\sin\theta = \frac{-9}{\sqrt{106}}$, $\cos\theta = \frac{-5}{\sqrt{106}}$, $\tan\theta = \frac{9}{5}$, $\sec\theta = \frac{-\sqrt{106}}{5}$, $\csc\theta = \frac{-\sqrt{106}}{9}$, $\cot\theta = \frac{5}{9}$

49. $\sin\alpha = \frac{-\sqrt{11}}{6}$, $\cos\alpha = \frac{-5}{6}$, $\tan\alpha = \frac{\sqrt{11}}{5}$, $\sec\alpha = \frac{-6}{5}$, $\csc\alpha = \frac{-6}{\sqrt{11}}$, $\cot\alpha = \frac{5}{\sqrt{11}}$

51. $\sin\theta = \frac{s}{4}$, $\cos\theta = \dfrac{\sqrt{16-s^2}}{4}$, $\tan\theta = \dfrac{s}{\sqrt{16-s^2}}$, $\sec\theta = \dfrac{4}{\sqrt{16-s^2}}$, $\csc\theta = \dfrac{4}{s}$,
$\cot\theta = \dfrac{\sqrt{16-s^2}}{s}$ 53. $\sin\theta = \dfrac{w}{\sqrt{w^2+144}}$, $\cos\theta = \dfrac{-12}{\sqrt{w^2+144}}$, $\tan\theta = \dfrac{-w}{12}$,
$\sec\theta = \dfrac{-\sqrt{w^2+144}}{12}$, $\csc\theta = \dfrac{\sqrt{w^2+144}}{w}$, $\cot\theta = \dfrac{-12}{w}$ 55. $\sin\alpha = \dfrac{k}{2}$,
$\cos\alpha = \dfrac{-\sqrt{4-k^2}}{2}$, $\tan\alpha = \dfrac{-k}{\sqrt{4-k^2}}$, $\sec\alpha = \dfrac{-2}{\sqrt{4-k^2}}$, $\csc\alpha = \dfrac{2}{k}$, $\cot\alpha = \dfrac{-\sqrt{4-k^2}}{k}$

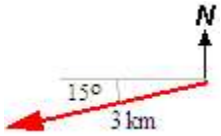
57. $\sin\theta = 0.3$, $\cos\theta = -0.4$, $\tan\theta = -0.75$, $\sec\theta = -2.5$, $\csc\theta = 3.33$, $\cot\theta = -1.33$

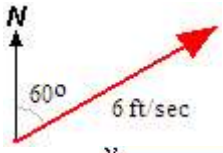
59. -8 61. $\sqrt{2}$ 63. $\theta \approx 2.8$, $\theta \approx 0.30$ 65. $y = \csc x$ or $y = \cot x$
67. $y = \sec x$ 69. $y = \sec x$ or $y = \csc x$ 71. $f(x) = \sin x - 1$
73. $G(x) = \tan x - 1$ 75. $\cos^2 x$ 77. $\cos^2 B$
79. $\csc\theta$ 81. $\sqrt{3}\tan\theta\sin\theta$

83a. $AC = \tan\alpha$, $DC = \tan\beta$, $AD = \tan\alpha - \tan\beta$ b. They are right triangles that share $\angle B$.

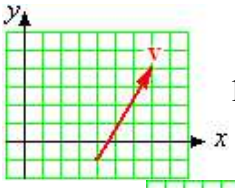
c. $\angle A = \angle F$, $\angle B$ is the complement of $\angle A$, and $\angle FDC$ is the complement of $\angle F$.
d. $\frac{CF}{CD} = \tan\alpha$, so $CF = \tan\alpha \tan\beta$ e. They are right triangles with $\angle A = \angle F$.
f. $\angle EBD = \alpha - \beta$, so $\tan(\alpha - \beta) = \frac{\text{opp}}{\text{adj}} = \frac{DE}{BE}$; $\frac{DE}{BE}$ and $\frac{AD}{BF}$ are ratios of corresponding sides of similar triangles; $AD = \tan\alpha - \tan\beta$ by part (a), $BF = BC + CF = 1 + \tan\alpha \tan\beta$ by part (d).
85. $d = 25\csc 112°$, $\alpha = 45°$, $a \approx 19.07$, $b \approx 10.54$

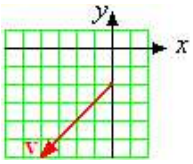
Homework 9.1

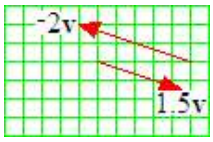
1. 

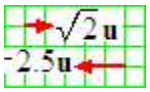
3. 

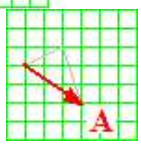
5. 

7. **A** and **E** 9. **H** and **K** 11. 

13. 

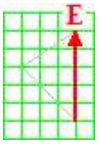
15. 

17. 

19. 

$\|\mathbf{A}\| = \sqrt{13}$, $\theta = -33.7°$

21. 

$\|\mathbf{C}\| = 1$, $\theta = 90°$ 23. 

$\|\mathbf{E}\| = 5$, $\theta = 90°$

25. 

$\|\mathbf{G}\| = 4$, $\theta = 180°$ 27. $||\mathbf{v}|| = 13$, $\theta = -67.38°$

29. $||\mathbf{v}|| = \sqrt{85} \approx 9.22$, $\theta = 229.4°$ 31. 

$||\mathbf{v} + \mathbf{w}|| = 32.9$, $\theta = 109.3°$

33. 

$||\mathbf{v} + \mathbf{w}|| = 11.4$, $\theta = 162.4°$

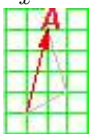
35. 

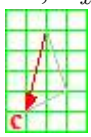
4.47 mi, 23.4° east of north

37. 

129.4 mph, 85.4° west of north

39a. $v_x = 10$, $v_y = 10\sqrt{3}$, $w_x = 5\sqrt{2}$, $w_y = -5\sqrt{2}$ b. 19.9 mph, 59° east of north
41a. $v_x \approx -1.23$, $v_y \approx 3.38$, $w_x \approx -0.32$, $w_y \approx -2.23$ b. 1.9 km, 54.5° west of north

43. 

45. 

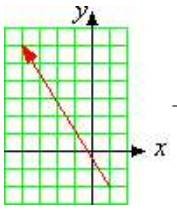
47. 

49. 

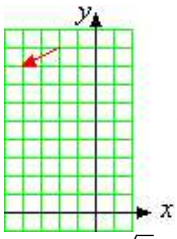
51. $u_x = 2$, $u_y = 1$, $v_x = 1$, $v_y = -3$, $A_x = 1$, $A_y = 4$; $A_x = u_x - v_x$, $A_y = u_y - v_y$

Homework 9.2

1. $\mathbf{u} = 3\mathbf{i} + 2\mathbf{j}$ a. $\sqrt{13}$ b. $6\mathbf{i} + 4\mathbf{j}$ c. $2\sqrt{13}$
3. $\mathbf{w} = 6\mathbf{i} - 3\mathbf{j}$ a. $3\sqrt{5}$ b. $-6\mathbf{i} + 3\mathbf{j}$ c. $3\sqrt{5}$
5a. $\mathbf{u} + \mathbf{v} = -2\mathbf{i} + 5\mathbf{j}$ and $\|\mathbf{u} + \mathbf{v}\| = \sqrt{29}$ b. $||\mathbf{u}|| + ||\mathbf{v}|| \geq ||\mathbf{u} + \mathbf{v}||$

7a.  $-5\mathbf{i}+8\mathbf{j}$

b. $||\mathbf{v}|| = \sqrt{89}, \theta = 122°$

9a.  $-2\mathbf{i}-\mathbf{j}$

b. $||\mathbf{v}|| = \sqrt{5}, \theta = 206.6°$

11a. $18\mathbf{i}+12\mathbf{j}$

b. $||\mathbf{v}|| = 6\sqrt{13}, \theta = 33.7°$

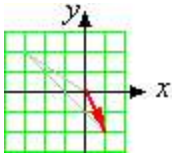
13. $\|\mathbf{v}\| = 6\sqrt{2},\ \theta = 135°$

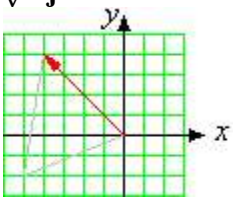
15. $\|\mathbf{w}\| = 14,\ \theta = -30°$

17. $\|\mathbf{q}\| = 4\sqrt{745},\ \theta = 61.56°$

19. $\mathbf{v} = 3\sqrt{2}\mathbf{i} - 3\sqrt{2}\mathbf{j}$

21. $\mathbf{v} \approx 6.629\mathbf{i} + 4.995\mathbf{j}$

23.  $\mathbf{i}-2\mathbf{j}$

25.  $-4\mathbf{i}+4\mathbf{j}$

27. $12\mathbf{i}+3\mathbf{j}$

29. $2.8\mathbf{i}+1.9\mathbf{j}$

31. $-3\mathbf{i}+7\mathbf{j}$

33. $-8\mathbf{i}-20\mathbf{j}$

35. $14\mathbf{i}-9\mathbf{j}$

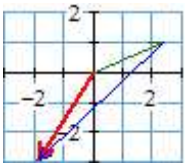
37. $-9\mathbf{i}+23\mathbf{j}$

39. $\frac{-12}{13}\mathbf{i}+\frac{5}{13}\mathbf{j}$

41. $\frac{1}{\sqrt{2}}\mathbf{i}-\frac{1}{\sqrt{2}}\mathbf{j}$

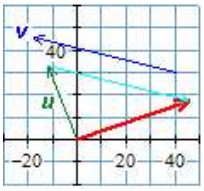
43. $24\mathbf{i}+45\ \mathbf{j}$

45. $\frac{-12}{\sqrt{10}}\mathbf{i}+\frac{4}{\sqrt{10}}\mathbf{j}$

47a. 

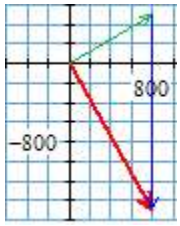
b. $\mathbf{u} \approx 2.393\mathbf{i}+1.016\mathbf{j}$,
$\mathbf{v} \approx -4.242\mathbf{i}-3.956\mathbf{j}$,

c. $-1.849\mathbf{i}-2.940\mathbf{j}$

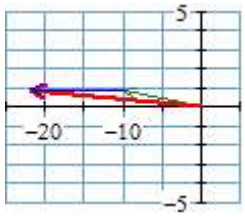
49a. 

b. $\mathbf{u} \approx -11.97\mathbf{i}+32.889\mathbf{j}$,
$\mathbf{v} \approx -57.955\mathbf{i}+15.529\mathbf{j}$

c. $45.98\mathbf{i}+17.36\mathbf{j}$

51a. 

b. 1700 m, 28.1° east of south

53a. 

b. 21.98 km, 2.27° north of west

55a. 

b. 83 mi, 62° east of north

57a. $-4\mathbf{i}-5\mathbf{j}$ b. $4\mathbf{i}+5\mathbf{j}$

59a. $\mathbf{i}-3\mathbf{j}$ b. $-\mathbf{i}+3\mathbf{j}$

61a. $\|\mathbf{v}\| = 10, 2\|\mathbf{v}\| = 20 = 2\cdot 10$

b. $\|k\mathbf{v}\| = \sqrt{(ka)^2+(kb)^2} = k\sqrt{a^2+b^2}$

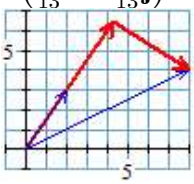
Homework 9.3

1. $\frac{33}{\sqrt{13}}$

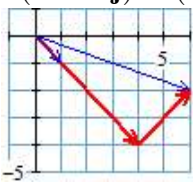
3. $\frac{-1}{\sqrt{2}}$

5. $-2\sqrt{5}$

7a. $\mathbf{w} = \left(\frac{56}{13}\mathbf{i}+\frac{84}{13}\mathbf{j}\right)+\left(\frac{48}{13}\mathbf{i}-\frac{32}{13}\mathbf{j}\right)$

b. 

9a. $\mathbf{w} = (4\mathbf{i}-4\mathbf{j})+(2\mathbf{i}+2\mathbf{j})$

b. 

11. 22

13. 0

15. 12

17. -318.2

19. not orthogonal

21. orthogonal

23. 4.4°

25. 97.1°

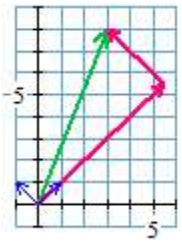
27. 8 29. -10 31. -21 33. $42\mathbf{i} - 28\mathbf{j}$

35. 4 37. 38.57 lbs 39. 1289 lb

41a. $\frac{1}{\sqrt{2}}\mathbf{i} + \frac{1}{\sqrt{2}}\mathbf{j}$ and $\frac{-1}{\sqrt{2}}\mathbf{i} + \frac{1}{\sqrt{2}}\mathbf{j}$

b. $\mathbf{u} \cdot \mathbf{v} = 0$

c. $\frac{11}{\sqrt{2}}$ and $\frac{5}{\sqrt{2}}$

d. 

43. $\mathbf{v} \cdot \mathbf{v} = c^2 + d^2$ 45. $k\mathbf{u} \cdot \mathbf{v} = kac + kbd = k(ac + bd) = (akc + bkd)$

47. $(\mathbf{u} - \mathbf{v}) \cdot (\mathbf{u} + \mathbf{v}) = (a - c)(a + c) + (b - d)(b + d) = (a^2 + b^2) - (c^2 + d^2)$

49. $\frac{a \cdot 1 + b \cdot 0}{1} = a$ and $\frac{a \cdot 0 + b \cdot 1}{1} = b$

51a. Both $\mathbf{i} \cdot \mathbf{i} = 1$ and $\mathbf{j} \cdot \mathbf{j} = 1$ because $1 \cdot 1 \cos 0 = 1$; $\mathbf{i} \cdot \mathbf{j} = 1 \cdot 1 \cos 90° = 0$

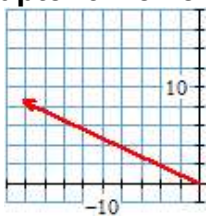
b. $(a\mathbf{i} + b\mathbf{j}) \cdot (c\mathbf{i} + d\mathbf{j}) = ac(1) + ad(0) + bc(0) + bd(1) = ac + bd$

53a. $\|\mathbf{u} - \mathbf{v}\|^2 = (\mathbf{u} - \mathbf{v}) \cdot (\mathbf{u} - \mathbf{v}) = \mathbf{u} \cdot \mathbf{u} - 2\mathbf{u} \cdot \mathbf{v} + \mathbf{v} \cdot \mathbf{v}$

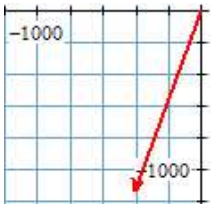
$= \|\mathbf{u}\|^2 - 2\|\mathbf{u}\|\|\mathbf{v}\|\cos\theta + \|\mathbf{v}\|^2$

b. Let $a = \|\mathbf{u}\|$, $b = \|\mathbf{v}\|$, $c = \|\mathbf{u} - \mathbf{v}\|$, and $C = \theta$

Chapter 9 Review

1. 

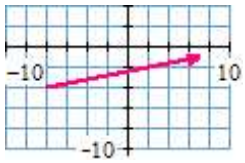
$v_N = 8.45$ mph, $v_E = -18.13$ mph

3. 

$v_N = -1127.63$ lbs, $v_E = -410.42$ lbs

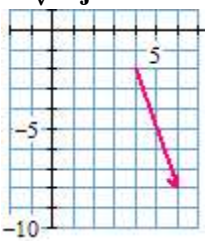
5. $||\mathbf{A}|| = 10.8,\ \theta = 236.3°$

7. $\mathbf{i} - \sqrt{3}\,\mathbf{j}$

9a. 

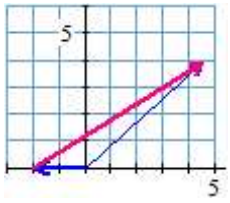
$15\,\mathbf{i} + 3\,\mathbf{j}$

b. $||\mathbf{v}|| = 15.3,\ \theta = 11.3°$

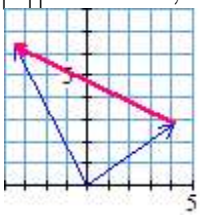
11a. 

$2\,\mathbf{i} - 6\,\mathbf{j}$

b. $||\mathbf{v}|| = 6.3$ mi, $\theta = 288.4°$

13. 

7.64 km, $\theta = 30.31°$

15. 

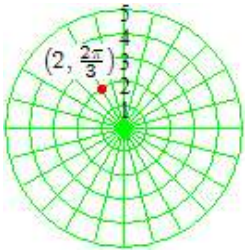
8.46 mi, $\theta = 155.6°$

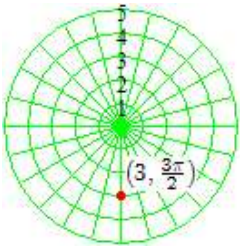
17a. $\mathbf{F_1} = -200\,\mathbf{i}$, $\mathbf{F_2} = -60\sqrt{2}\,\mathbf{i} - 60\sqrt{2}\,\mathbf{j}$, $\mathbf{F_3} = 50\sqrt{3}\,\mathbf{i} + 50\,\mathbf{j}$, $\mathbf{F_4} = 125\,\mathbf{i} + 125\sqrt{3}\,\mathbf{j}$

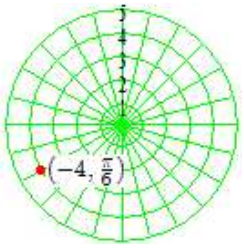
b. $-73.25\,\mathbf{i} + 181.65\,\mathbf{j}$ 19. $13\,\mathbf{i} + 5\,\mathbf{j}$ 21. $-7\,\mathbf{i} - 14\,\mathbf{j}$

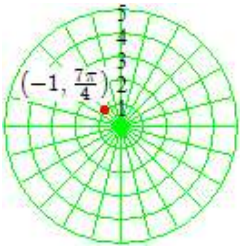
23. $\frac{2}{\sqrt{13}}\,\mathbf{i} + \frac{3}{\sqrt{13}}\,\mathbf{j}$ 25. $\frac{-6}{\sqrt{29}}\,\mathbf{i} - \frac{15}{\sqrt{29}}\,\mathbf{j}$ 27. -3.45 29. -8.08 31. $106.26°$

Homework 10.1

1. 

3. 

5. 

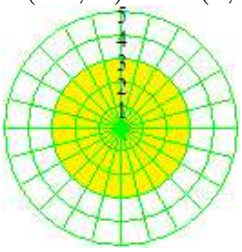
7. 

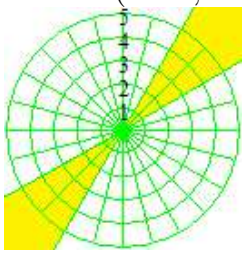
9. $(5, \frac{3\pi}{4})$ 11. $(1, \pi)$ 13. $(3, \frac{4\pi}{3})$ 15. $(2, \frac{\pi}{12})$ 17. $(-3, 3\sqrt{3})$

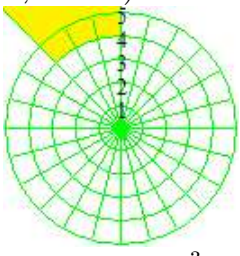
19. $(\frac{3}{\sqrt{2}}, \frac{-3}{\sqrt{2}})$ 21. $(-2.15, -1.06)$ 23. $(-0.14, -1.99)$ 25. $(7\sqrt{2}, \frac{\pi}{4})$

27. $(2\sqrt{2}, \frac{11\pi}{6})$ 29. $(\sqrt{13}, \pi + \tan^{-1}\frac{2}{3})$ 31. $(2, \pi)$ 33a. $(-2, \frac{11\pi}{6})$ b. $(2, \frac{-7\pi}{6})$

35a. $(-3, 0)$ b. $(3, -\pi)$ 37a. $(-2.3, 2.06)$ b. $(2.3, -1.08)$

39. 

41. 

43. 

45. $r \geq 0,\ \frac{\pi}{6} \leq \theta \leq \frac{\pi}{3}$ 47. $r \geq 1,\ \frac{\pi}{2} \leq \theta \leq \pi$ 49. $-1 \leq r \leq 1,\ \frac{3\pi}{4} \leq \theta \leq \pi$

51. $x^2 + y^2 = 2$ 53. $x^2 + y^2 = 4x$ 55. $y = 1$

57. $y = 2x$ 59. $x^2 + y^2 = 3x$ 61. $x^2 = 4 - 4y$

63. $2x + y = 1$ 65. $r = 2\sec\theta$ 67. $2r^2 = \sec\theta\csc\theta$

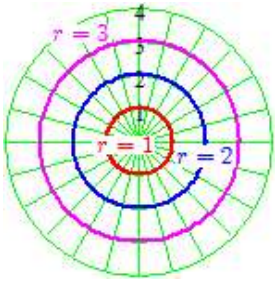
69. $r = 4\cot\theta\csc\theta$ 71. $r = 4$

73. $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} = \sqrt{(r_2\cos\theta_2 - r_1\cos\theta_1)^2 + (r_2\sin\theta_2 - r_1\sin\theta_1)^2}$

$= \sqrt{r_2^2\cos^2\theta_2 - 2r_2r_1\cos\theta_2\cos\theta_1 + r_1^2\cos^2\theta_1 + r_2^2\sin^2\theta_2 - 2r_2r_1\sin\theta_2\sin\theta_1 + r_1^2\sin^2\theta_1}$

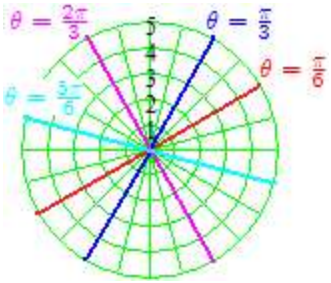
$= \sqrt{r_2^2 + r_1^2 - 2r_2r_1(\cos\theta_2\cos\theta_1 - \sin\theta_2\sin\theta_1)} = \sqrt{r_2^2 + r_1^2 - 2r_2r_1\cos(\theta_2 - \theta_1)}$

Homework 10.2

1a. 

k is the radius.

b. $x^2 + y^2 = 1,\ x^2 + y^2 = 4,\ x^2 + y^2 = 9$

3a. 

$\tan k$ is the slope.

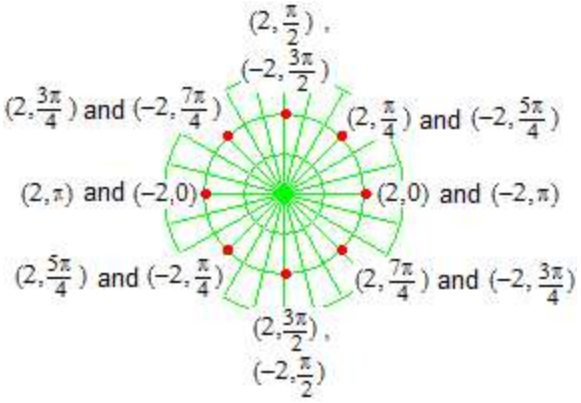
b. $y = \frac{x}{\sqrt{3}},\ y = \sqrt{3}x,\ y = -\sqrt{3}x,\ y = \frac{-x}{\sqrt{3}}$

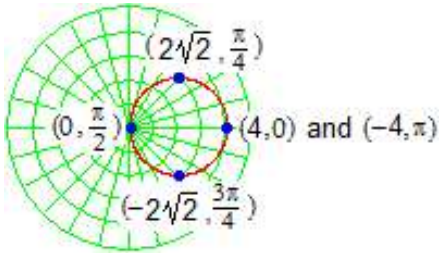
5.

θ	0	$\frac{\pi}{4}$	$\frac{\pi}{2}$	$\frac{3\pi}{4}$	π	$\frac{5\pi}{4}$	$\frac{3\pi}{2}$	$\frac{7\pi}{4}$
$r = 2$	2	2	2	2	2	2	2	2

θ	0	$\frac{\pi}{4}$	$\frac{\pi}{2}$	$\frac{3\pi}{4}$	π	$\frac{5\pi}{4}$	$\frac{3\pi}{2}$	$\frac{7\pi}{4}$
$r = -2$	-2	-2	-2	-2	-2	-2	-2	-2

The $r = 2$ graph begins at the right-most point (and proceeds counter-clockwise); the $r = -2$ graph begins at the left-most point.



7a. 

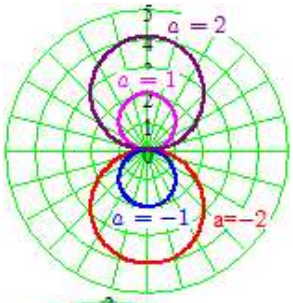
b.

θ	π	$\frac{5\pi}{4}$	$\frac{3\pi}{2}$	$\frac{7\pi}{4}$	2π
r	-4	$-2\sqrt{2}$	0	$2\sqrt{2}$	4

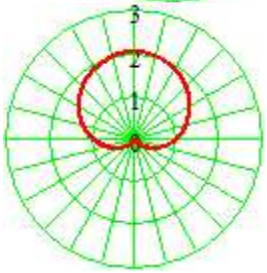
The graph is traced again.

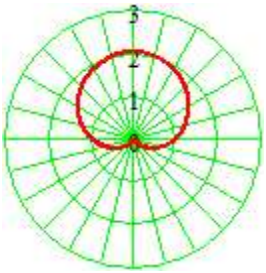
c. center: $(2, 0)$, radius: 2

d. $(x-2)^2 + y^2 = 4$

9a. 

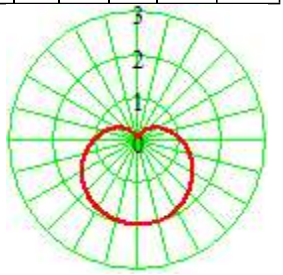
b. For $a > 0$, a is the radius of a circle centerd on the positive y-axis; for $a < 0$, $|a|$ is the radius of a circle centerd on the negative y-axis.

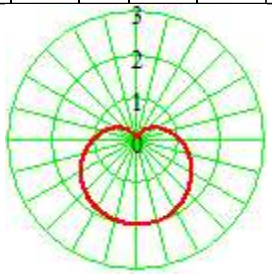
11a. 

b. 

θ	0	$\frac{\pi}{2}$	π	$\frac{3\pi}{2}$	2π
r	1	2	1	0	1

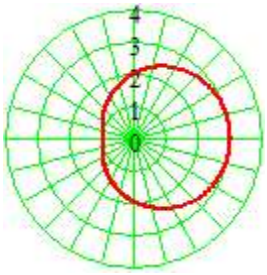
θ	0	$\frac{\pi}{2}$	π	$\frac{3\pi}{2}$	2π
r	-1	0	-1	-2	-1

c. 

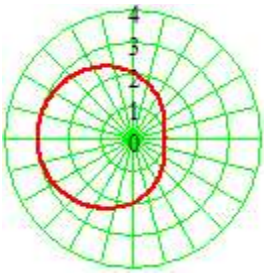
d. 

θ	0	$\frac{\pi}{2}$	π	$\frac{3\pi}{2}$	2π
r	1	0	1	2	1

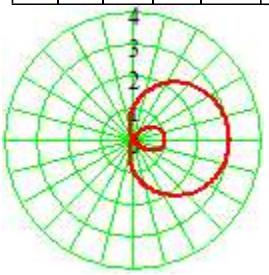
θ	0	$\frac{\pi}{2}$	π	$\frac{3\pi}{2}$	2π
r	-1	-2	-1	0	-1

13a. 

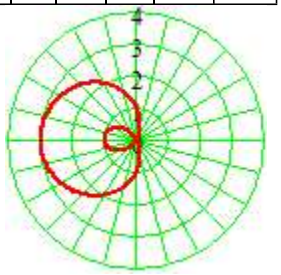
θ	0	$\frac{\pi}{2}$	π	$\frac{3\pi}{2}$	2π
r	3	2	1	2	3

b. 

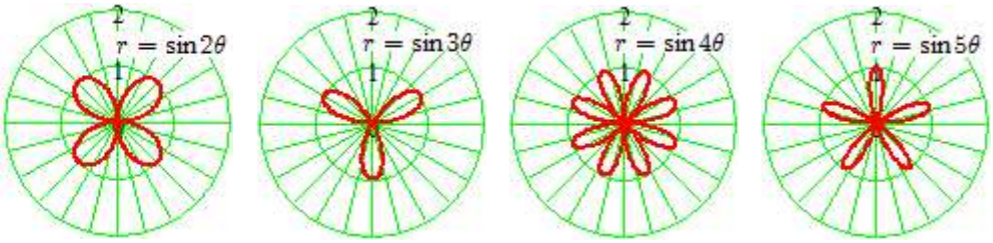
θ	0	$\frac{\pi}{2}$	π	$\frac{3\pi}{2}$	2π
r	1	2	3	2	1

c. 

θ	0	$\frac{\pi}{2}$	π	$\frac{3\pi}{2}$	2π
r	3	1	-1	1	3

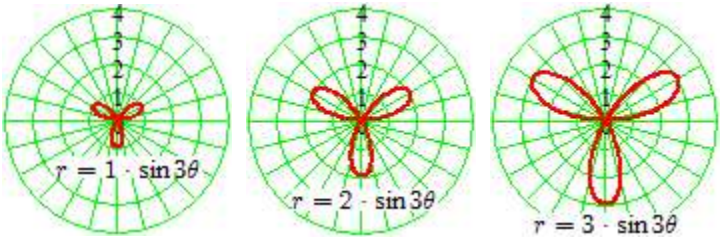
d. 

θ	0	$\frac{\pi}{2}$	π	$\frac{3\pi}{2}$	2π
r	-1	1	3	1	-1

15a. 

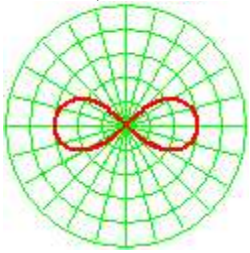
There are n petals if n is odd, and $2n$ petals if n is even.

b. $n = 2:\ \frac{\pi}{4},\ \frac{3\pi}{4},\ \frac{5\pi}{4},\ \frac{7\pi}{4};\ n = 3:\ \frac{\pi}{6},\ \frac{5\pi}{6},\ \frac{3\pi}{2};\ n = 4:\ \frac{\pi}{8},\ \frac{3\pi}{8},\ \frac{5\pi}{8},\ \frac{7\pi}{8},\ \frac{9\pi}{8},\ \frac{11\pi}{8},\ \frac{13\pi}{8},\ \frac{15\pi}{8};$
$n = 5:\ \frac{\pi}{10},\ \frac{\pi}{2},\ \frac{9\pi}{10},\ \frac{13\pi}{10},\ \frac{17\pi}{10}$

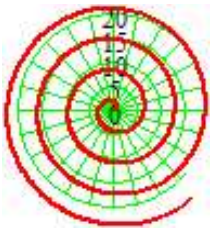
c. 

a is the length of the petal.

17a. $r = \pm 3\sqrt{\cos 2\theta}$

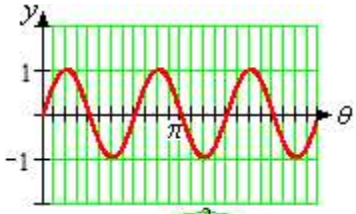
b. 

c. a is the length of the loop

19. 

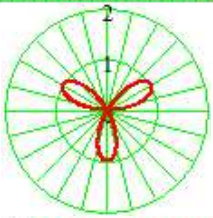
21a.

θ	0	$\frac{\pi}{12}$	$\frac{\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$	$\frac{5\pi}{12}$	$\frac{\pi}{2}$	$\frac{7\pi}{12}$	$\frac{2\pi}{3}$
3θ	0	$\frac{\pi}{4}$	$\frac{\pi}{2}$	$\frac{3\pi}{4}$	π	$\frac{5\pi}{4}$	$\frac{3\pi}{2}$	$\frac{7\pi}{4}$	2π
y	0	$\frac{\sqrt{2}}{2}$	1	$\frac{\sqrt{2}}{2}$	0	$\frac{-\sqrt{2}}{2}$	-1	$\frac{-\sqrt{2}}{2}$	0



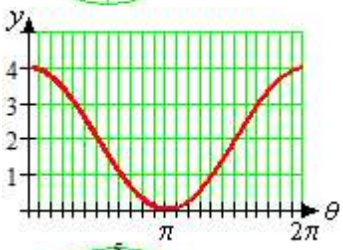
b.

θ	0	$\frac{\pi}{12}$	$\frac{\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$	$\frac{5\pi}{12}$	$\frac{\pi}{2}$	$\frac{7\pi}{12}$	$\frac{2\pi}{3}$
3θ	0	$\frac{\pi}{4}$	$\frac{\pi}{2}$	$\frac{3\pi}{4}$	π	$\frac{5\pi}{4}$	$\frac{3\pi}{2}$	$\frac{7\pi}{4}$	2π
r	0	$\frac{\sqrt{2}}{2}$	1	$\frac{\sqrt{2}}{2}$	0	$\frac{-\sqrt{2}}{2}$	-1	$\frac{-\sqrt{2}}{2}$	0



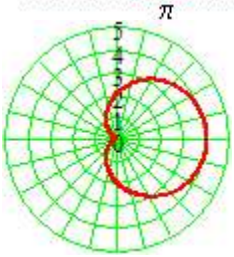
23a.

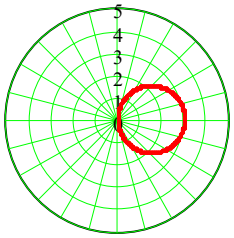
θ	0	$\frac{\pi}{4}$	$\frac{\pi}{2}$	$\frac{3\pi}{4}$	π	$\frac{5\pi}{4}$	$\frac{3\pi}{2}$	$\frac{7\pi}{4}$	2π
y	4	$2+\sqrt{2}$	2	$2-\sqrt{2}$	0	$2-\sqrt{2}$	2	$2+\sqrt{2}$	4

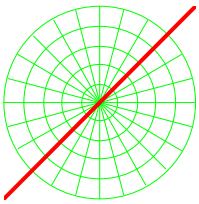


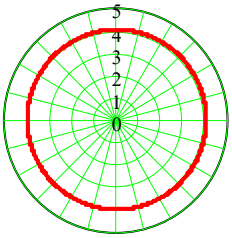
b.

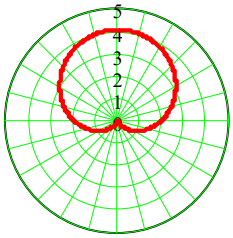
θ	0	$\frac{\pi}{4}$	$\frac{\pi}{2}$	$\frac{3\pi}{4}$	π	$\frac{5\pi}{4}$	$\frac{3\pi}{2}$	$\frac{7\pi}{4}$	2π
r	4	$2+\sqrt{2}$	2	$2-\sqrt{2}$	0	$2-\sqrt{2}$	2	$2+\sqrt{2}$	4

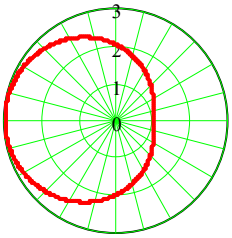


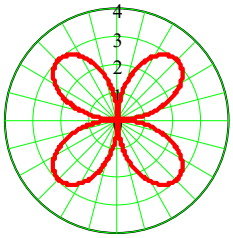
25. circle 

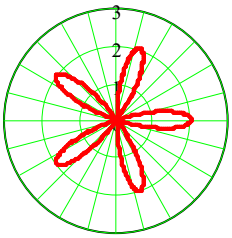
27. line 

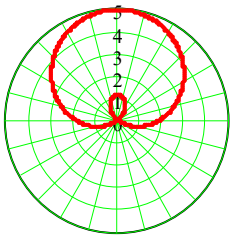
29. circle 

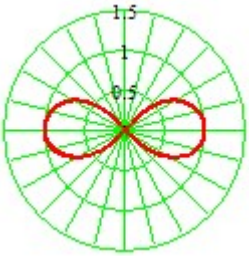
31. cardioid 

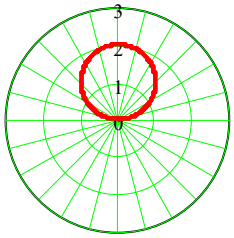
33. limaçon 

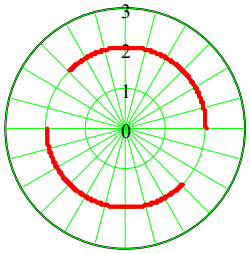
35. rose 

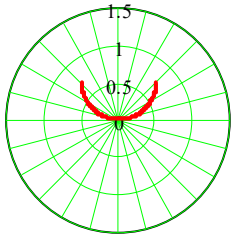
37. rose 

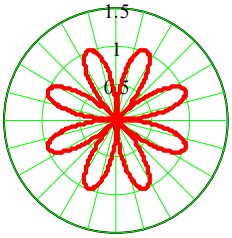
39. limaçon 

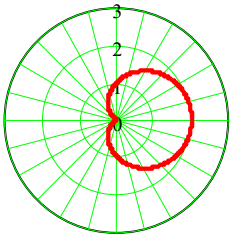
41. leminiscate 

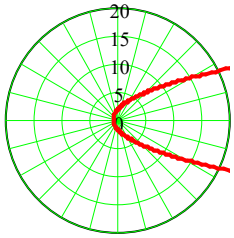
43. circle 

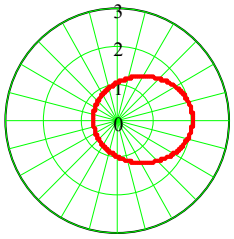
45. arcs of circle 

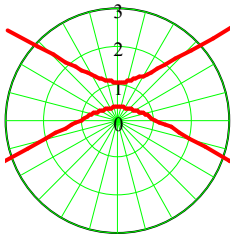
47. semicircle 

49. rose 

51. cardioid 

53. parabola 

55. ellipse 

57. hyperbola 

59. $r = 2 + 2\cos\theta$

61. $r = 3\sin 5\theta$

63. $r = 5\sin\theta$

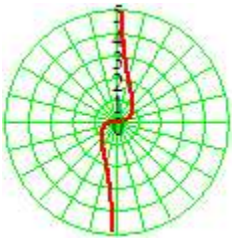
65. $r = 1 + 2\cos\theta$

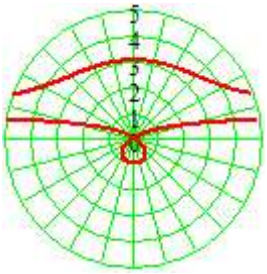
67. $(0,0)$, $(\frac{1}{2}, \frac{\pi}{3})$, $(\frac{1}{2}, \frac{5\pi}{3})$

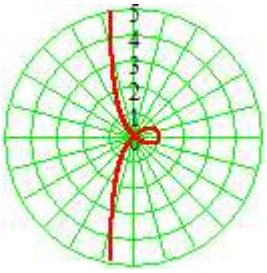
69. $(0,0)$, $(\frac{3}{\sqrt{2}}, \frac{\pi}{4})$, $(\frac{-3}{\sqrt{2}}, \frac{5\pi}{4})$

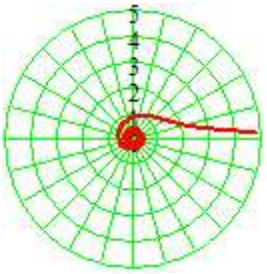
71. $(1, \frac{\pi}{2})$, $(1, \frac{3\pi}{2})$

73. $(\frac{4+\sqrt{2}}{2}, \frac{3\pi}{4})$, $(\frac{4-\sqrt{2}}{2}, \frac{7\pi}{4})$

75. 

77. 

79. 

81. 

83. The curve has n large loops and n small loops.

Homework 10.3

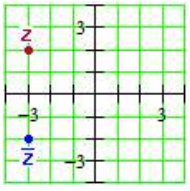
1a. $5i - 4$ b. $-4 + i$ c. $\frac{-5}{6} - \frac{\sqrt{2}}{6}i$ 3. $-3 \pm 2i$ 5. $\frac{1}{6} \pm \frac{\sqrt{11}}{6}i$

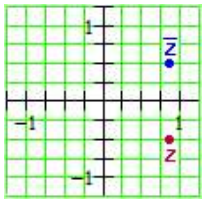
7. $13 + 4i$ 9. $-0.8 + 3.8i$ 11. $20 - 10i$ 13. $-14 + 34i$

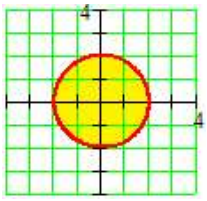
15. $46 + 14i\sqrt{3}$ 17. 52 19. $-2 - 2i$ 21. $-1 + 4i$ 23. $\frac{35}{3} + \frac{20}{3}i$

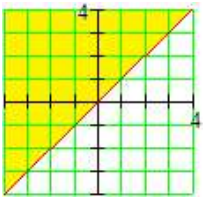
25. $\frac{-25}{29} + \frac{10}{29}i$ 27. $\frac{3}{4} - \frac{\sqrt{3}}{4}i$ 29. $\frac{-2}{3} + \frac{\sqrt{5}}{3}i$ 31. i

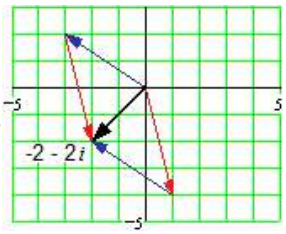
33a. -1 b. 1 c. $-i$ d. -1 35a. 0 b. 0 37a. 0 b.0 39a. 0 b. 0

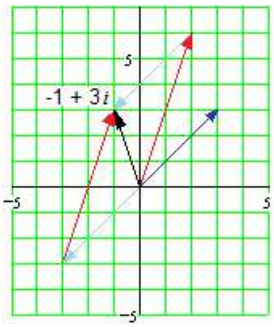
41. $4z^2 + 49$ 43. $x^2 + 6x + 10$ 45. $v^2 - 8v + 17$ 47. 

49. 

51. 

53. 

55. 

57. 

59. $(a+bi)(c+di) = ac + adi + bci + bdi^2$
$= (ac - bd) + (ad + bc)i$

61. $z_1 + z_2 = (a+bi) + (c+di)$
$= (a+c) + (b+d)i = (c+a) + (d+b)i$
$= (c+di) + (a+bi) = z_2 + z_1$
$z_1 z_2 = (a+bi)(c+di) = (ac - bd) + (ad + bc)i$
$= (ca - db) + (da + cb)i = z_2 z_1$

63a. $z + \overline{z} = (a+bi) + (a-bi) = 2a$; $z - \overline{z} = (a+bi) - (a-bi) = -2bi$

b. $z\overline{z} = (a+bi)(a-bi) = a^2 + b^2 = |z|^2$

65. No. Let $t = i$ and $z = -i$. Then $w = t + z = i - i = 0$, so $|w| = 0$, but $|t| + |z| = |i| + |-i| = 1 + 1 = 2$.

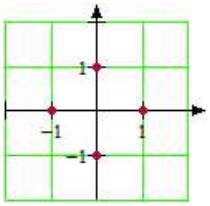
67a. $2 - \sqrt{5}$ b. $x^2 - 4x - 1 = 0$

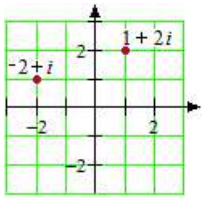
69a. $4 + 3i$ b. $x^2 - 8x + 25 = 0$

71. $x^4 - 6x^3 + 23x^2 - 50x + 50 = 0$

73. $x^4 - 7x^3 + 20x^2 - 19x + 13 = 0$

Homework 10.4

1. $1, i, -1, -i, 1$: 

3. $1 + 2i, -2 + i$: 

5. $-3 + 3i\sqrt{3}$

7. $-1 + i$

9. $2.34 - 4.42i$

11. $-5.07 + 10.88i$

13. $3(\cos\frac{\pi}{2} + i\sin\frac{\pi}{2})$, $3(\cos\frac{3\pi}{2} + i\sin\frac{3\pi}{2})$

15. $2\sqrt{3}\,(\cos\frac{7\pi}{6} + i\sin\frac{7\pi}{6})$, $2\sqrt{3}(\cos\frac{11\pi}{6} + i\sin\frac{11\pi}{6})$

17. $4.47\,(\cos 2.68 + i\sin 2.68)$, $4.47\,(\cos 5.82 + i\sin 5.82)$

19. $8.60\,(\cos 5.78 + i\sin 5.78)$, $8.60\,(\cos 0.51 + i\sin 0.51)$

21. $5\,(\cos 0.93 + i\sin 0.93)$, $5\,(\cos 5.36 + i\sin 5.36)$, $5\,(\cos 2.21 + i\sin 2.21)$, $5\,(\cos 4.07 + i\sin 4.07)$

23. If $z = r\,(\cos\theta + i\sin\theta)$, then $\overline{z} = r\,(\cos(2\pi - \theta) + i\sin(2\pi - \theta))$

25. $z_1 z_2 = 2\,(\cos\frac{\pi}{6} + i\sin\frac{\pi}{6}) = \sqrt{3} + i$; $\frac{z_1}{z_2} = 8(\cos\frac{\pi}{2} + i\sin\frac{\pi}{2}) = 8i$

27. $z_1 z_2 = 6\,(\cos\frac{9\pi}{10} + i\sin\frac{9\pi}{10})$; $\frac{z_1}{z_2} = \frac{3}{2}(\cos\frac{3\pi}{10} + i\sin\frac{3\pi}{10})$

29. $z_1 z_2 = 8$; $\frac{z_1}{z_2} = \frac{1}{2}$

31. $z_1 z_2 = 4\sqrt{2}\,(\cos\frac{7\pi}{12} + i\sin\frac{7\pi}{12})$; $\frac{z_1}{z_2} = 2\sqrt{2}(\cos\frac{13\pi}{12} + i\sin\frac{13\pi}{12})$

33. $-128 - 128i$

35. $-128 - 128\sqrt{3}\,i$

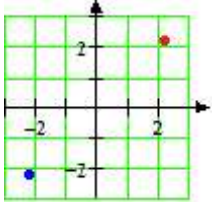
37. $512 + 512\sqrt{3}\,i$

39. $\frac{1}{4} + \frac{1}{4}i$

41. $\frac{-\sqrt{2}}{8} - \frac{\sqrt{6}}{8}i$

43a. $3\,(\cos\frac{\pi}{4} + i\sin\frac{\pi}{4})$, $3\,(\cos\frac{3\pi}{4} + i\sin\frac{3\pi}{4})$

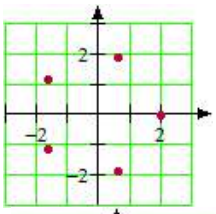
b. $\frac{3}{\sqrt{2}} + \frac{3}{\sqrt{2}}i$, $\frac{-3}{\sqrt{2}} - \frac{3}{\sqrt{2}}i$



$2\,(\cos\frac{6\pi}{5} + i\sin\frac{6\pi}{5})$, $2\,(\cos\frac{8\pi}{5} + i\sin\frac{8\pi}{5})$

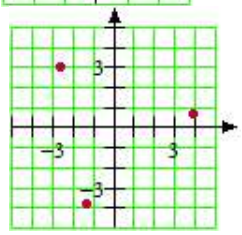
45a. 2, $2\,(\cos\frac{2\pi}{5} + i\sin\frac{2\pi}{5})$, $2\,(\cos\frac{4\pi}{5} + i\sin\frac{4\pi}{5})$,

b. $2,\ 0.618 + 1.9i,\ -1.618 + 1.176i,$
$-1.618 - 1.176i,\ 0.618 - 1.902i$



47a. $4\left(\cos\frac{\pi}{18} + i\sin\frac{\pi}{18}\right),\ 4\left(\cos\frac{13\pi}{18} + i\sin\frac{13\pi}{18}\right),$
$4\left(\cos\frac{25\pi}{18} + i\sin\frac{25\pi}{18}\right)$

b. $1.97 + 0.347i,\ -1.286 + 1.532i,$
$-0.684 - 1.879i$



49. $|z| = |\cos\theta + i\sin\theta| = \sqrt{\cos^2\theta + \sin^2\theta} = 1$

51a. $1,\ \left(\cos\frac{2\pi}{3} + i\sin\frac{2\pi}{3}\right),\ \left(\cos\frac{4\pi}{3} + i\sin\frac{4\pi}{3}\right)$ b. $1,\ i,\ -1,\ -i$

c. $1,\ \left(\cos\frac{2\pi}{5} + i\sin\frac{2\pi}{5}\right),\ \left(\cos\frac{4\pi}{5} + i\sin\frac{4\pi}{5}\right),\ \left(\cos\frac{6\pi}{5} + i\sin\frac{6\pi}{5}\right),\ \left(\cos\frac{8\pi}{5} + i\sin\frac{8\pi}{5}\right)$

d. $1,\ \left(\cos\frac{\pi}{3} + i\sin\frac{\pi}{3}\right),\ \left(\cos\frac{2\pi}{3} + i\sin\frac{2\pi}{3}\right),\ -1,\ \left(\cos\frac{4\pi}{3} + i\sin\frac{4\pi}{3}\right),\ \left(\cos\frac{5\pi}{3} + i\sin\frac{5\pi}{3}\right)$

53. $\omega_k^n = 1^n\left(\cos n\cdot\frac{2\pi k}{n} + i\sin n\cdot\frac{2\pi k}{n}\right) = 1(\cos 2\pi k + i\sin 2\pi k) = 1$

55. $8^{1/4}\left(\cos\frac{3\pi}{8} + i\sin\frac{3\pi}{8}\right),\ 8^{1/4}\left(\cos\frac{5\pi}{8} + i\sin\frac{5\pi}{8}\right),\ 8^{1/4}\left(\cos\frac{11\pi}{8} + i\sin\frac{11\pi}{8}\right),$
$8^{1/4}\left(\cos\frac{13\pi}{8} + i\sin\frac{13\pi}{8}\right)$

57. $\sqrt{2},\ \sqrt{2}\left(\cos\frac{\pi}{3} + i\sin\frac{\pi}{3}\right),\ \sqrt{2}\left(\cos\frac{2\pi}{3} + i\sin\frac{2\pi}{3}\right),\ -\sqrt{2},\ \sqrt{2}\left(\cos\frac{4\pi}{3} + i\sin\frac{4\pi}{3}\right),$
$\sqrt{2}\left(\cos\frac{5\pi}{3} + i\sin\frac{5\pi}{3}\right)$

59. $\sqrt{2}\left(\cos\frac{\pi}{3} + i\sin\frac{\pi}{3}\right),\ \sqrt{2}\left(\cos\frac{2\pi}{3} + i\sin\frac{2\pi}{3}\right),\ \sqrt{2}\left(\cos\frac{4\pi}{3} + i\sin\frac{4\pi}{3}\right),$
$\sqrt{2}\left(\cos\frac{5\pi}{3} + i\sin\frac{5\pi}{3}\right)$

61a. $\cos^2\theta - \sin^2\theta + (2\sin\theta\cos\theta)i$ b. $\cos 2\theta + i\sin 2\theta$

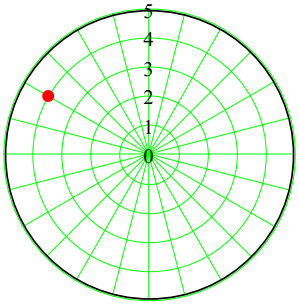
c. $\sin 2\theta = 2\sin\theta\cos\theta;\ \cos 2\theta = \cos^2\theta - \sin^2\theta$

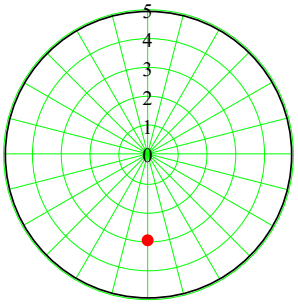
63a. $\frac{b}{a}$ b. $\frac{-a}{b}$ c. $-1,\ \frac{\pi}{2}$

65a. $z_1z_2 = (ac - bd) + (ad + bc)i$ b. $a = r\cos\alpha, b = r\sin\alpha, c = R\cos\beta, d = R\sin\beta$

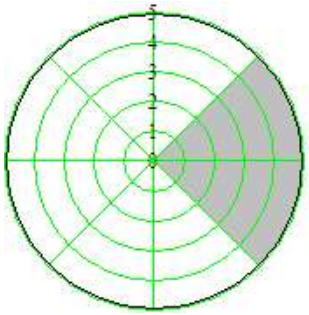
c,d. $ac - bd = rR\cos\alpha\cos\beta - rR\sin\alpha\sin\beta = rR\cos(\alpha + \beta),$
$ad + bc = rR\cos\alpha\sin\beta + rR\sin\alpha\cos\beta = rR\sin(\alpha + \beta)$

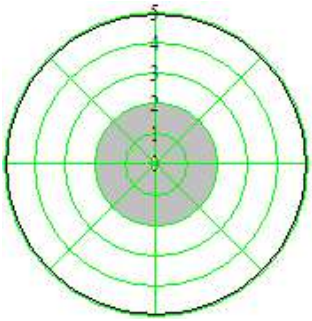
Chapter 10 Review

1. 

3. 

5. $\left(\frac{-\sqrt{2}}{2}, \frac{-\sqrt{2}}{2}\right)$ 7. $(0.241, -3.391)$ 9. $\left(3\sqrt{2}, \frac{3\pi}{4}\right)$ 11. $\left(\sqrt{29}, \tan^{-1}\left(\frac{-2}{5}\right) + 2\pi\right)$

13. 

15. 

17. $x^2 + y^2 = 1$

19. $x^2 + y^2 = (2x + 6)^2$

21. $r\cos\theta + r\sin\theta = 2$

23. $\tan\theta = r$

25. Circle of radius 3 centered at the origin

27. Circle of radius 3 centered at $(3, 0)$

29. $r = 4$

31. $r = 4\cos\theta$

33. $\left(4, \frac{\pi}{6}\right), \left(4, \frac{5\pi}{6}\right)$

35. $\left(2\sqrt{2}, \frac{3\pi}{4}\right)$ and the pole

37. $4 - 3i$

39. $-2 + 4i$

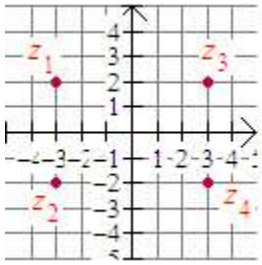
41. a. 1 b. 1

43. a. -44 b. -44

45. $(2 \pm i)^2 - 4(2 \pm i) + 5 = (4 \pm 4i - 1) - (8 \pm 4i) + 5 = 0$

47. $z^2 + 4z + 5$

49. $s^2 - 10s + 41$

51. 

53. a. $-1 - 7i$ b. $x^2 + 2x + 50 = 0$

55. a. $3 + \sqrt{2}\,i$ b. $x^2 - 6x + 11 = 0$

57. $5\sqrt{3} - 5i$

59. $5 + 5i$

61. $3\sqrt{2}\left(\cos\frac{7\pi}{4} + i\sin\frac{7\pi}{4}\right)$

63. $5(\cos\pi + i\sin\pi)$

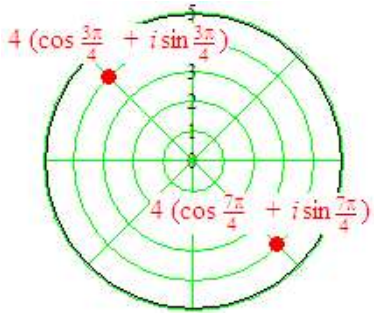
65. $2\left(\cos\frac{4\pi}{3} + i\sin\frac{4\pi}{3}\right)$

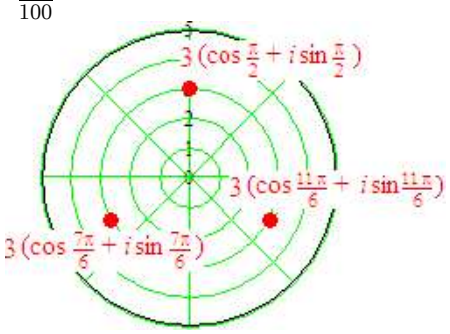
67. $z_1 z_2 = 16(\cos\pi + i\sin\pi) = -16$, $\frac{z_1}{z_2} = 4\left(\cos\frac{-2\pi}{3} + i\sin\frac{-2\pi}{3}\right) = -2 - 2\sqrt{3}\,i$

69. $z_1 z_2 = \frac{5}{2}\left(\cos\frac{-\pi}{3} + i\sin\frac{-\pi}{3}\right) = \frac{5}{4} - \frac{5\sqrt{3}}{2}i$, $\frac{z_1}{z_2} = 10\left(\cos\frac{-5\pi}{6} + i\sin\frac{-5\pi}{6}\right) = -5\sqrt{3} - 5\,i$

71. 1

73. $\frac{-1}{100}$

75. a. 

77a. 

b. $-2\sqrt{2} + 2\sqrt{2}i, 2\sqrt{2} - 2\sqrt{2}i$

b. $3i, \frac{-3\sqrt{3}}{2} - \frac{3}{2}\,i, \frac{3\sqrt{3}}{2} - \frac{3}{2}\,i$

79. $3(\cos\theta + i\sin\theta)$, for $\theta = \frac{\pi}{6}, \frac{\pi}{2}, \frac{5\pi}{6}, \frac{7\pi}{6}, \frac{3\pi}{2}, \frac{11\pi}{6}$

81. $\sqrt{2}(\cos\theta + i\sin\theta)$, for $\theta = \frac{\pi}{3}, \frac{2\pi}{3}, \frac{4\pi}{3}, \frac{5\pi}{3}$